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MELTZER (J.). **Het onderzoek van acariciden en spintoviciden in het laboratorium.** [The Investigation of Acaricides and Ovicides against the Red Spider Mite in the Laboratory.]—*Tijdschr. PlZiekt.* **61** pt. 4 pp. 130–142, 1 pl., 11 refs. Wageningen, 1955. (With a Summary in English.)

The use of modern insecticides on fruit trees has been accompanied by increases in infestation by *Metatetranychus ulmi* (Koch). This is often attributed to destruction of natural enemies of the mite, but the author has observed some evidence in Holland that it may be due to the favourable conditions created by the elimination of food competitors, particularly Aphids. Control of the winter eggs with DNC requires supplementing by summer sprays, and investigations on new acaricides were carried out in the laboratory, the test species being *Tetranychus telarius* (L.) (*urticae* Koch), which resembles *M. ulmi* in susceptibility to some toxicants. In tests against the adults, bean plants were dipped in the acaricides and allowed to dry, and adult females 2–4 days old were then confined on the leaves. In tests against the immature stages, bean plants bearing eggs were dipped or females were confined on the dry deposits on dipped plants for 2–3 days, the eggs laid being examined after a further eight days, by which time eggs on untreated plants had given rise to deutonymphs. The mortality percentages were corrected according to Abbott's formula [*cf. R.A.E.*, A **13** 331].

The phosphorus compounds tested were primarily effective against the adults. Parathion at 12·5 parts per million gave complete kill of females immediately and three days after treatment of the plants, but it did not give complete mortality of dipped eggs even at 600 p.p.m., though the nymphs that hatched from the surviving eggs all died. Mortality of eggs laid on dried deposits was very low, though 95–100 per cent. of the nymphs from such eggs died when the concentration was 200–600 p.p.m. Malathion was inferior against all stages. Diazinon (O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate) at 100 p.p.m. gave complete mortality in one day of the initial females and in three days of those placed on the leaves five days after treatment, and 1,000 p.p.m. gave complete kill of females placed on the leaves seven days after treatment. All nymphs from eggs dipped in Diazinon at 300 p.p.m. died after hatching, though egg mortality was very low. Karathane (2,4-dinitro-6-(1-methylheptyl)phenyl crotonate) at 1,000 p.p.m. gave complete kill of initial females and 98 per cent. mortality of those placed on the leaves five days after treatment, and all the nymphs died after hatching from eggs dipped or laid on leaves that had been dipped at that concentration. DMC (1,1-bis(p-chlorophenyl)ethanol) at 125 p.p.m. gave complete mortality of females in seven days; at 100 p.p.m. it killed 99 per cent. of dipped eggs and 68 per cent. of those laid on dried deposits, and mortality of nymphs from the eggs was complete at 50 p.p.m. Chlorobenzilate (ethyl 4,4′dichlorobenzilate) gave complete kill of adults within seven days at 500 p.p.m., and at 100 p.p.m. it killed 86 per cent. of the dipped eggs and all the nymphs from surviving eggs.

The sulphur compounds tested, Sulphenone (p-chlorophenyl phenyl sulphone), diphenyl sulphone, CPBS (p-chlorophenyl benzenesulphonate), CPCBS (p-chlorophenyl p-chlorobenzenesulphonate), chlorbenside (p-chlorobenzyl p-chlorophenyl sulphide) and Tedion (2,4,5,4′-tetrachlorodiphenyl sulphone), were mostly effective against the eggs and young nymphs. In tests at 1,000 p.p.m. against adult females, only the first was toxic, giving 95 per cent. kill, but it had little effect on the eggs. Diphenyl sulphone was effective against dipped eggs only. CPCBS at 10, 100, and 300 p.p.m. gave 54, 79 and 86 per cent. mortality, respectively, of dipped eggs, and the nymphs from the surviving eggs died on hatching. It was much less

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effective against eggs laid on dried deposits. CPBS at 300 p.p.m. gave 75 and 93 per cent. kill of eggs that had been dipped or laid on dried deposits, respectively, and nymphs from the remainder died. Chlorbenside at 300 p.p.m. gave complete mortality of dipped eggs and those laid on the dried deposits, and Tedion gave 95–100 per cent. kill of eggs laid on dried deposits at 3–300 p.p.m. and 90–99 per cent. kill of dipped eggs at 30–300 p.p.m., all nymphs from the surviving eggs dying on hatching.

It is concluded that two treatments within ten days are necessary to obtain good control with the phosphorus products. The sulphur compounds maintain their effectiveness well, but are generally not toxic to the adults, so that in cases of heavy infestation, it is necessary to add a product such as TEPP [tetraethyl pyrophosphate] or rotenone to the ovicide used, to kill the adult mites.

Georgala (M. B.). **A Contribution to the Biology of the Pear Sucker, *Psylla pyricola* Foer.**—*44th Rep. E. Malling Res. Sta. 1955–56* pp. 135–141, 1 pl., 3 figs., 4 refs. East Malling, 1957.

Psylla pyricola Först. is generally distributed on pear in Kent and other south-eastern counties of England, and its bionomics were investigated there between March 1955 and January 1956, with a view to facilitating the timing of control measures.

There were three generations in the field in 1955, and observations, made mainly in the insectary, showed that the overwintered females and those of the first and second summer generations deposited averages of 216·4, 192·7 and 143·1 eggs [*cf. R.A.E.*, A **41** 97] in 31·3, 15·8 and 59·9 days, respectively, the summer individuals living for averages of 25 and 73·6 days, with preoviposition periods of 9·2 and 7·4 days. The egg and nymphal stages averaged 22 and 30·9 days, respectively, for the first generation, 10·5 and 22·6 for the second, and 8 and 28·8 for the third (overwintering) generation. Eggs of the three generations were found on pear in the field in April and May, from mid-June to late July, and from early August to late October, respectively, and nymphs throughout May and June, from mid-June to late August and from early August to early December. Eggs of the first generation were laid mainly in bark crevices, and those of the later ones on the leaves; the nymphs fed mainly on the leaves until these dropped in late October, and then on the current season's wood near the buds. Adult emergence reached peaks in June, late July and mid-October, and adults of the last generation overwintered, mainly on the spur growth of pear trees, and persisted in very small numbers until the first week of June. However, populations then consisted mainly of nymphs and young adults, and this is considered to be the best time to apply control measures.

The eggs and nymphs were destroyed by *Anthocoris nemorum* (L.), and *Trechnites psyllae* (Ruschka), *Psyllaephagus* sp. and *Lygocerus* sp. were reared from mummies of fifth-instar nymphs of the first generation; no parasitism was noted in the later generations. Infestation was sporadic until the emergence of the first-generation adults, but the foliage was in poor condition by the end of the second generation, when it had suffered also from attack by *Metatetranychus ulmi* (Koch) and fungus disease. Although the nymphs of *Psylla pyricola* produced abundant honeydew in July and August, there was no excessive development of sooty mould.

Briggs (J. B.). **Some Experiments on Control of Ground Beetle Damage to Strawberry.**—*44th Rep. E. Malling Res. Sta. 1955–56* pp. 142–145, 1 pl., 6 refs. East Malling, 1957.

Since 1952, strawberry fruits at East Malling have been damaged by adults of *Harpalus rufipes* (Deg.) and probably *H. aeneus* (F.), which

remove the seeds, and by those of *Feronia melanaria* (Ill.) and *F. madida* (F.), which hollow out the flesh. Investigations in 1955–56 showed that the eggs of *H. rufipes* are laid in well-compacted weedy soil from mid-July until late September. The larvae hatched in 2–3 weeks, were common in strawberry beds in autumn, where they probably feed on fallen seeds, and were found at depths of 2–18 ins. at the edges of the beds in winter. They pupated in the soil, and the newly emerged adults came to the surface in late July. The females did not oviposit until the following summer and continued to lay eggs for one or more seasons thereafter, being active at night from April to late November and overwintering in the soil near the strawberry beds at depths of 4–8 ins. under matted grass. The bionomics of the less numerous *H. aeneus* were similar. The eggs of *F. melanaria* were laid in the soil in August and September, and the larvae were taken in traps in strawberry beds from August until April. Pupae were found in late May, a few inches below a strawberry plant, and adults emerged in early June and were abundant in the beds until early September. Full-fed larvae and pupae of *F. madida* were observed in gardens and woods and at the edges of fields, and the adults were less common than those of *F. melanaria* in strawberry beds.

To reduce the damage by these Carabids, strawberries should not be planted near grassy areas or other places where the beetles may overwinter, the surrounding soil should be cultivated before and after cropping to deprive the adults of shelter and food, and the straw should be left in the fields for as little time as possible. In the laboratory, dieldrin and aldrin gave promising control of the adults, but DDT was ineffective. In a small-scale plot test, an emulsion spray of 0·2 per cent. dieldrin applied on 20th June 1955, four days before picking began, reduced both forms of damage and also the numbers of *Feronia* trapped, but chemical analysis of fruits from the plots and from others sprayed with 0·1 per cent. dieldrin at various intervals before picking in 1956 showed dieldrin residues of 6–8 parts per million on fruits picked immediately after spraying and of 0·5–1 p.p.m. on those picked after 27–35 days, and it is concluded that any spray applied after the blossom opens is likely to leave harmful residues on the picked strawberries. Residues of 6–8 p.p.m. on the fruits killed all adults of *H. rufipes* and *F. melanaria* exposed to them in the laboratory in 48 hours, whereas 0·5–1 p.p.m. caused no mortality.

Tew (R. P.) & Groves (J. R.). **Some Observations on the Effects of Formulation on the Persistence of DDT and its Toxicity to certain Orchard Insects and Mites.**—*44th Rep. E. Malling Res. Sta. 1955–56* pp. 152–160, 3 graphs, 8 refs. East Malling, 1957.

Earlier tests having shown that DDT gave better control of *Cydia* (*Enarmonia*) *pomonella* (L.) on apple in southern England than other materials, but resulted in marked increases in *Metatetranychus ulmi* (Koch) [*cf. R.A.E.*, A **45** 235], the effects of different formulations of DDT were investigated in 1953–54. Five suspensions or emulsified solutions of 0·1 per cent. DDT with surfactants or other adjuvants were applied in 1953, and seven, with controls, in 1954. Large variations in population between trees in 1953 and a low incidence of the pest in 1954 prevented assessment of their relative merits against *C. pomonella*. There were no differences between treatments in populations of *M. ulmi* in 1953, though the degree of damage varied somewhat, but comparison with the controls (surfactants or adjuvants only) in 1954 showed that the use of DDT resulted in large increases in the mite, the increases being greater for emulsified solutions than for suspensions, and also in increases in *Bryobia*. Predacious mites

of the genus *Typhlodromus* were reduced by all DDT treatments, particularly by the emulsified solutions, which left more persistent residues, but as doubt has been thrown on the importance of these predators for the control of *M. ulmi* [*cf.* next abstract], and insect predators were rare in both years, the increases in *M. ulmi* were evidently not entirely due to the elimination of natural enemies. Comparison of deposits with the population levels on the different trees lent some support to the view that DDT stimulates the fecundity of *M. ulmi* [*cf.* **43** 341].

Chant (D. A.). **Predacious Spiders and Mites on Fruit Trees.**—*44th Rep. E. Malling Res. Sta. 1955–56* pp. 175–178, 1 fig. East Malling, 1957.

The author discusses the importance of spiders as predators, particularly of the red spider mite [*Metatetranychus ulmi* (Koch)], in apple orchards in Kent and Essex and concludes that they feed on such a variety of insects and mites that attempts to use them for control would not be justified. Sprays are detrimental to them, owing to their mechanical or their chemical action, and spiders are therefore less abundant in sprayed than in unsprayed orchards.

Of the nine species of predacious Phytoseiid mites found on unsprayed fruit trees, only *Typhlodromus tiliae* Oudm. tolerates conditions in sprayed orchards [*cf. R.A.E.*, A **44** 292]. These mites have 3–4 generations a year and overwinter as the adult females. They usually suffer over 90 per cent. mortality during the winter, and are attacked by predacious insects. Unlike *M. ulmi*, they are rarely found on the upper surfaces of the leaves and are most abundant on the younger leaves throughout the season. They have been considered to afford important control of *M. ulmi* [*cf.* **41** 158], but laboratory and field tests showed that they are not completely predacious. Adults survived for a long time with no food but apple leaves [*cf.* **44** 292], and the immature stages developed normally and the females oviposited on diets of pollen grains and fungus spores. They attacked examples of their own species and all other mites found on fruit trees, and developed about twice as fast when provided with small mites, such as *Vasates schlechtendali* (Nal.) or *V. fockeui* (Nal. & Trt.), of which they consumed up to 90 a day each, as when provided with *M. ulmi*, of which they consumed only 2–3 a day and did not attack the eggs. Individuals that have recently fed on *M. ulmi* show a red coloration, but this was observed in less than half the examples collected during a severe outbreak of *M. ulmi* in 1955, indicating that alternative food was used extensively, even when *M. ulmi* was abundant. Removing predacious mites by hand from young unsprayed apple trees did not affect the density of *M. ulmi* over a period of two years, and it is therefore concluded that, like spiders, these mites are of doubtful value as predators of *M. ulmi*.

Radha (K.), Nirula (K. K.) & Menon (K. P. V.). **The Green Muscardine Disease of *Oryctes rhinoceros* L. II. The causal Organism.**—*Indian Cocon. J.* **9** no. 2 pp. 83–89, 1 fig., 9 refs. Ernakulam, 1956.

In this part of a series on *Metarrhizium anisopliae* infesting *Oryctes rhinoceros* (L.) [*cf. R.A.E.*, A **45** 210], the results are given of a comparative study of cultures of this fungus isolated respectively from *O. rhinoceros* and *Pyrilla* sp. in India, a culture originating from *O. rhinoceros* and obtained from California, and one of unknown origin from Holland. It was confirmed that it exists in a long-spored form, in which the length of the spores ranges from 10·6 to 12μ, and a short-spored one, in which the range is 3·5–8·2μ.

The long-spored form was obtained only from *O. rhinoceros* in India, and the cultures derived from this beetle were the only ones that caused symptoms to develop in healthy larvae of *O. rhinoceros* into which they were injected, the cultures of Indian and Californian origin causing 85–100 and 75–80 per cent. infection, respectively. When the spores were injected through the spiracles or at the anterior end of the body, the larvae all died in seven days, but when they were injected at the posterior end of the body or applied as a spray, the larvae appeared healthy after seven days but died in a fortnight.

Nirula (K. K.). **Investigations on the Pests of Coconut Palm. Part III. *Nephantis serinopa* Meyrick.**—*Indian Cocon. J.* **9** no. 2 pp. 101–131, 17 figs. Ernakulam, 1956.

In this third part of a series [*cf. R.A.E.*, A **45** 142], the author describes all stages of *Nephantis serinopa* Meyr., which is an occasional but injurious pest of coconut in coastal districts of southern India, and gives a detailed account of observations on its bionomics, much of the information in which has already been noticed [*cf.* **43** 231], and its natural enemies. The larvae feed on the leaves, and 50 per cent. crop reduction in the year following maximum defoliation is not unusual during outbreaks in some areas on the west coast. Defoliation also results in a constriction in the trunk, and, in young palms, stunting and retarded growth. In addition to the parasites already noticed [**29** 620], *N. serinopa* in India is parasitised by a Tachinid of the genus *Winthemia*, which occasionally attacks the larvae on the west coast, and *Trichogramma minutum* Ril., which parasitises a small proportion of the eggs in one district on the east coast. The predators that attack *N. serinopa* include the Carabid, *Parena nigrolineata* (Chaud.) (*latecincta* (Bates)), which feeds on the larvae in their galleries, and the Reduviid, *Sphedanolestes aurescens* Dist., which destroys both eggs and larvae.

Pingale (S. V.). **Impregnation of Jute Bag Containers with Insecticides for protecting stored Foodstuffs. II. Efficiency of Lindane.**—*Indian J. Ent.* **17** (1955) pt. 3 pp. 295–306, 11 refs. New Delhi, 1956.

As previous work showed that impregnating jute bags with mixtures of pyrethrins and piperonyl butoxide did not protect the contents from attack by *Calandra* [*R.A.E.*, A **43** 187], tests were made with γ BHC (lindane). Pieces of jute fabric were soaked in emulsified solutions at various concentrations and dried in the sun, and adults of *C. oryzae* (L.), *Rhizopertha dominica* (F.) and *Latheticus oryzae* Waterh. and larvae of *Ephestia cautella* (Wlk.) that had not fed for 24 hours were confined on them for two hours after various intervals. Mortality counts made 48 hours later showed that doses of 10 and 30 mg. γ BHC per sq. ft. were effective against all but *E. cautella* one month and six months after impregnation, respectively, and 15 mg. or more was effective against *E. cautella* for one month, but not longer. When added as a synergist for the BHC [*cf.* **40** 197], piperonyl butoxide (1:1) proved rather more effective than sesame oil at 10:1 or cashew-shell oil at 20:1, which approximately equalled each other, but all prolonged the effect of the 10-mg. dosage of γ BHC for several months.

When uninfested grain in small treated and untreated bags was stored in a room into which adults of *C. oryzae*, *R. dominica*, *L. oryzae*, *Tribolium castaneum* (Hbst.) and *Callosobruchus chinenis* (L.) and eggs of *E. cautella* were introduced once a month, 15 mg. γ BHC per sq. ft. or 5 mg. with 5 mg. piperonyl butoxide, 0·05 ml. sesame oil or 0·1 ml. cashew-shell oil gave some

protection from attack for eight months, but similar tests with heavily infested grain showed that a dosage of 10–15 mg. γ BHC synergised with 0·1–0·15 ml. sesame oil per sq. ft. was necessary to give complete control of all but *E. cautella* and *T. castaneum* for six months. Similar, but rather less complete control was obtained in bags of commercial size, and treatment with 15 mg. synergised γ BHC per sq. ft. is recommended as the best available for commercial storage, which usually lasts 8–10 months.

Storage for six months in bags treated with 25 or 50 mg. γ BHC per sq. ft. caused no contamination of grain or groundnut kernels but the higher dosage caused slight contamination of wheat flour.

Agarwala (S. B. D.) & Haque (M. W.). **Studies on *Argyria sticticraspis* Dudgeon—the early Shoot-borer of Sugarcane in Bihar.**—*Indian J. Ent.* **17** (1955) pt. 3 pp. 307–314, 6 refs. New Delhi, 1956.

Chilotraea infuscatella (Sn.) (*Argyria sticticraspis* (Hmps.)) is widely distributed on sugar-cane in Bihar, and the larvae cause serious damage by boring in the shoots. In observations at Pusa, it was not found on wild species of *Saccharum* except in the vicinity of sugar-cane, where *S. munja* and *S. arundinaceum* were infested. Its incidence on the cane was highest during the early season, when it attacked the spring-planted crop, and after the monsoon, when it caused injury for the rest of the year.

Investigations on its bionomics showed that adults of the overwintering generation emerge towards the end of February and oviposit in early March. Larvae of the first generation infested autumn-planted canes and shoots standing in harvested fields, became full-fed in 27–28 days and gave rise to adults from mid-April, about a week after pupating. Larvae of the second generation fed on autumn- and spring-planted cane for about 24–32 days, beginning about the fourth week of April, and sometimes caused serious losses. The third generation fed for about 22–25 days between the second week of June and the last of July, and the fourth for 32–44 days between the first week of August and the end of September. Eggs of the fifth generation were laid at the beginning of October, and the larvae overwintered. The generations overlapped increasingly as the season progressed. Observations on oviposition, which usually occurred on the outer surface of the leaves, showed that the females deposited 112–608 eggs each in 2–14 masses of 4–100 in a maximum of four days. The eggs hatched in 4–8 days, the adults survived for 3–8 days, and the ratio of males to females was 1 : 5 in the first generation and about 1 : 2 in the others.

Pradhan (S.) & Jotwani (M. G.). **Bio-assay of Insecticides—IV. Comparative Toxicity of some important Insecticides to *Utetheisa pulchella* Linn. (Arctiidae, Lepidoptera).**—*Indian J. Ent.* **17** (1955) pt. 3 pp. 315–316, 6 refs. New Delhi, 1956.

In this fourth part of a series [*cf. R.A.E.*, A **44** 17, etc.], the results are given of laboratory tests of insecticides in India against field-collected larvae of *Utetheisa pulchella* (L.). The insecticides were dissolved in benzene and used to impregnate talc for application as dusts or emulsified with Triton X-155 for use as sprays, and the median lethal dosages were assessed from the mortalities 72 hours after treatment. These showed that technical aldrin, dieldrin, isodrin and endrin, respectively, were 88·14, 89·15, 160·7 and 264·2 per cent. as toxic as γ BHC in dusts and 75·86, 92·47, 338·8 and 732·1 per cent. as toxic in sprays.

Rattan Lal & Haque (E.). **Effect of Nutrition under controlled Conditions of Temperature and Humidity on Longevity and Fecundity of** *Sphaerophoria scutellaris* **(Fabr.) (Syrphidae: Diptera)—Efficacy of its Maggots as Aphid Predators.**—*Indian J. Ent.* **17** (1955) pt. 3 pp. 317–325, 3 refs. New Delhi, 1956.

The Syrphid, *Sphaerophoria scutellaris* (F.), is of potential importance in India for the control of Aphids, particularly *Rhopalosiphum pseudobrassicae* (Davis), on which the larvae feed, and the effect of nutrition on its length of life and fecundity was therefore tested under controlled conditions of temperature and humidity [*cf. R.A.E.*, A **43** 151]. The following is based largely on the authors' summary of the results.

Rearing tests showed that the larvae completed their development in 12–13 days and destroyed 401–493 Aphids each at a temperature of 19·8°C. [67·64°F.] and 68·3 per cent. relative humidity, and completed their development in 8–9 days and consumed 308–339 Aphids each at 22·2°C. [71·96°F.] and 71 per cent. relative humidity. Experiments at 20, 25 and 30°C. [68, 77 and 86°F.] and 50, 70 and 90 per cent. relative humidity showed that both factors had an important effect on the survival and fecundity of the adults, which were significantly greater at 20 than at 25 or 30°C. and at 70 and 90 than at 50 per cent. relative humidity. At 25°C., the insects lived longer at 90 per cent. relative humidity than at 70 or 50 per cent., whereas at 20°C. they lived longer at 70 per cent. relative humidity than at 90 per cent. In tests on adult nutrition, sucrose, honey, fructose, glucose, maltose and mannitol were more effective in promoting longevity than starch, yeast or water; of the sugars, sucrose caused the greatest increase in length of life and fecundity. Artificial rearing of the predator should therefore be carried out at a temperature of 68°F. and 70 per cent. relative humidity, and sucrose should be provided for the adults.

Gupta (R. L.) & Gangrade (G. A.). **The Life-cycle and seasonal History of Chikoo-moth (***Nephopteryx eugraphella* **Rag.).**—*Indian J. Ent.* **17** (1955) pt. 3 pp. 326–336, 1 ref. New Delhi, 1956.

Nephopteryx eugraphella Rag., all stages of which are described, is one of the most important pests of *Achras zapota* at Nagpur, Madhya Pradesh [*cf. R.A.E.*, A **31** 40], the larvae feeding on the leaves or buds for most of the year. The trees flower in April–May and September–October, and investigations begun in 1946 showed that damage to the shoots is greatest in June and in September–October, when about 60 and 40 per cent. of them, respectively, are injured. In the laboratory, the females laid 148–374 eggs each, singly or in batches of 2–9, in 2–19 days, and the egg, larval and pupal stages and the complete life-cycle lasted about 2–4, 13–26, 8–13 and 26–38 days, respectively, in summer and 4–11, 21–60, 15–29 and 45–92 days in winter. There were 7–9 generations a year, and the only alternative foodplant of the Pyralid was *Mimusops elengi*. The larvae were parasitised by an Ichneumonid and two Braconids, which caused 9·5–14·5 per cent. mortality in 1946–48.

Seshadri (A. R.). **An extraordinary Outbreak of 'Caddice Flies' (Trichoptera) in the Mettur-dam Township Area in Salem District, South India.**—*Indian J. Ent.* **17** (1955) pt. 3 pp. 337–340, 1 fig., 3 refs. New Delhi, 1956.

Trichoptera are seldom of importance as pests, but *Amphipsyche indica* Martnv. has constituted a considerable nuisance in the Mettur-dam Township

area, in southern India, in the past 5–6 years. Breeding occurs in the reservoir and the channels leading from it, and the adults emerge in September–December and are attracted in large numbers to lights in the town, causing annoyance to pedestrians and the drivers of vehicles and making normal indoor life difficult. Their breeding habits are described, and control methods suggested. These include the lighting of bonfires near the breeding places to attract and destroy the adults, the use of powerful fluorescent lamps to localise the infestation, spraying the vegetation on the sides of the channels with DDT to kill the adults, and periodical scraping of larval incrustations off the rocks in shallow water and on partly exposed areas.

Narayanan (E. S.) & Mookherjee (P. B.). **Effect of Nutrition on the Longevity and Rate of Reproduction in** *Trichogramma evanescens minutum* **Riley (Chalcidoidea: Hymenoptera).**—*Indian J. Ent.* **17** (1955) pt. 3 pp. 376–382, 2 graphs, 5 refs. New Delhi, 1956.

As little is known of the importance of nutrition for adult Hymenopterous parasites, investigations were made in India on its effect on the length of life and reproduction rate of *Trichogramma minutum* Ril. Newly emerged adults reared from eggs of *Corcyra cephalonica* (Stnt.) were kept with no food, with tap water or an extract of the eggs of *C. cephalonica* only, with glucose, maltose, fructose or sucrose only, or with glucose and either skimmed milk, yeast extract or *Corcyra* egg extract, all at a constant temperature of 25°C. [77°F.] and 65 per cent. relative humidity.

Males and females that had not paired lived for 1–1·7 days with no food or only *Corcyra* egg extract, for 2·3–2·6 days with water only, for 4–6 and 9–10 days, respectively, with the different sugars, and for 3–4 and 3–8 days, respectively, with both glucose and protein. Males and females that paired but were not provided with host eggs lived a little more than a day with no food or only water, 4–5 and 7–10 days, respectively, with the sugars, and 2–3 and 2–4 days with glucose and protein, whereas males and females that paired and were provided with host eggs lived for a little over a day and two days, respectively, without food or with water, about five and 11–14 days with the sugars, and 2–3 and 3–8 days with glucose and protein. The females punctured the eggs and fed on their contents as well as on the other food provided, whereas the males did not appear to be attracted to the eggs. Fertilised females parasitised an average of 46·05 *Corcyra* eggs each when provided with no food, 81·3–106·6 with the sugars, 57·9–69·45 with glucose and protein, and 35·1 with water only. Of the four sugars, fructose had the most favourable effect on survival and fecundity. The poor results given by added protein probably indicate that the parasite cannot assimilate any quantity beyond what may ooze from the host egg when it is punctured.

Subba Rao (B. R.). *Microbracon chinensis* **Szep.—A short Note on the Technique of its Mass-multiplication.**—*Indian J. Ent.* **17** (1955) pt. 3 pp. 387–389, 1 fig., 1 ref. New Delhi, 1956.

The author describes a technique developed in India for the mass production of *Bracon* (*Microbracon*) *chinensis* Szépl., cocoons of which were shipped to the United States in 1953–54, for trial against various Lepidopterous borers [*cf. R.A.E.*, A **32** 405–406]. The adult parasites were kept in a wide-mouthed glass chimney, closed at each end with muslin, which was placed over freshly collected *Chilo* larvae on muslin on the wire-gauze lid

of a trough of water, to maintain the humidity, in a room with a constant temperature of 78°F. and 70 per cent. relative humidity. The females were attracted to the larvae within an hour or two, paralysed them with their ovipositors and deposited eggs loosely on them through the muslin, often in groups of 3–5; up to 40 eggs were found on a single larva. The parasitised larvae were removed after 24 hours, put on soft tissue paper in petri dishes and kept at a temperature of 30°C. [86°F.] and 70 per cent. relative humidity. When the parasite larvae were full-fed, they left the dead hosts and pupated in cocoons on the paper, the total life-cycle usually lasting 12–13 days. It was observed that parasite females confined singly failed to oviposit. Under field conditions, the cocoons of *M. chinensis* are sometimes heavily parasitised by a species of *Eurytoma*, so that cultures should be examined carefully before the parasite is released in the field.

Puttarudriah (M.) & Appanna (M.). **Two new Hosts of** *Helopeltis antonii* **Signoret in Mysore.**—*Indian J. Ent.* **17** (1955) pt. 3 pp. 391–392, 2 figs., 1 ref. New Delhi, 1956.

Helopeltis antonii Sign., which attacks numerous plants, was recently found infesting apple and grape in Mysore and is apparently becoming common on them. Observations showed that all stages occurred on the plants, and feeding by the nymphs and adults caused apple flowers to dry up and young fruits to develop a scabbed appearance, but did not affect older fruits. On grape vines, the insects attacked the tender leaves and developing fruits and caused the latter to dry up and fall.

Armstrong (T.), Dustan (G. G.) & Downing (R. S.). **A comparative Study of three Acaricides.**—*85th Rep. ent. Soc. Ont. 1954* pp. 5–17, 2 figs., 8 refs. [Guelph, Ont., 1955.]

Ovotran (p-chlorophenyl p-chlorobenzenesulphonate), PCPBS (p-chlorophenyl benzenesulphonate) and Chlorparacide (p-chlorobenzyl p-chlorophenyl sulphide) were tested in 1954 for the control of Tetranychid mites, 20 or 50 per cent. wettable powders and 20 per cent. emulsion concentrates being used. In greenhouse tests against *Tetranychus telarius* (L.) (*bimaculatus* Harvey) on runner beans, 0·04 per cent. suspensions of the three toxicants caused 70·1, 93·7 and 94·1 per cent. mortality, respectively, of eggs sprayed with them, and deposits from sprays of 0·15 per cent. Ovotran or PCPBS or 0·08 per cent. Chlorparacide (which was too phytotoxic for use at the higher concentration) remained ovicidal for about a month; this residual effect was greatest for PCPBS, which gave over 99 per cent. kill for 11 days and over 60 per cent. for 43–45 days. Painting the upper leaf surface with 0·12 per cent. suspensions of Chlorparacide, PCPBS and Ovotran, with a spreader, killed 76·4, 73·8 and 24·9 per cent. of eggs deposited within the next three days on the lower surface; Chlorparacide and Ovotran were somewhat more effective in emulsion than suspension, though the differences were not consistent at all concentrations. The three toxicants were about equally effective against larvae and protonymphs, suspension and emulsion sprays killing more than 65 per cent. in three days at 0·01 per cent. and, except for emulsified PCPBS, more than 90 per cent. at 0·04 per cent. Ovotran, PCPBS and Chlorparacide suspensions killed 17·7, 89·9 and 98·9 per cent. of the adults in three days at 0·2 per cent. and about 11, 88 and 14 per cent. at 0·05 per cent., a concentration that might be used in the orchard; 0·05 per cent. Ovotran in emulsion killed 91·4 per cent., as compared with 30 and 55·9 per cent. for PCPBS and Chlorparacide.

Orchard tests were carried out on apple, pear, plum and peach in Ontario and apple in British Columbia, *Metatetranychus ulmi* (Koch) being the principal species present. Dilute sprays of 1–2 lb. 20 per cent. Chlorparacide or 0·5 lb. 50 per cent. Ovotran or PCPBS per 100 gals. in Ontario and concentrated sprays of 4–8 lb. 50 per cent. Ovotran, 8 lb. 50 per cent. PCPBS and 16 lb. 20 per cent. Chlorparacide per acre in British Columbia gave commercial control throughout the season when applied once or twice shortly before or after flowering. *T. canadensis* (McG.) was evidently not controlled by early sprays of Ovotran or Chlorparacide, as it appeared on apple in one orchard in Ontario in July and was only slightly less numerous on sprayed than on unsprayed trees in August. Since all three materials are relatively ineffective against adult mites, sprays applied to well-established populations in July often failed to give good control until after two weeks, unless a quick-acting acaricide, such as Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], was added. No foliage or fruit injury occurred in limited tests on apple, peach and plum in Ontario, but Ovotran caused serious injury to Bartlett pears and slight foliage injury to some varieties of apple when applied at the pink stage in British Columbia. Chlorparacide occasionally caused slight injury at the pink stage and injured a few apples of one variety when applied in mid-June. PCPBS injured some varieties of apple, but not others, when applied in July.

Patterson (N. A.) & MacLellan (C. R.). **Control of the Codling Moth and other Orchard Pests with Ryania.**—*85th Rep. ent. Soc. Ont. 1954* pp. 25–32, 5 refs. [Guelph, Ont., 1955.]

As ryania appeared to give good experimental control of *Cydia* (*Carpocapsa*) *pomonella* (L.) and to affect few beneficial insects [*cf. R.A.E.*, A **43** 265; **45** 186], it was tested against this and other pests on apple in Nova Scotia in 1953–54. Only slight differences in effect on most orchard pests and on beneficial insects and mites were found between pure ryania and ryania activated with n-propyl isome [di-n-propyl 6,7-methylenedioxy-3-methyl-1,2,3,4-tetrahydronaphthalene-1,2-dicarboxylate], and fungicides did not reduce its effectiveness, with the possible exception of bordeaux mixture. *C. pomonella* has only one generation a year in Nova Scotia. Most of the eggs hatched between the end of June and the end of July in 1954, and 1–3 applications of 6 lb. ryania powder per 100 gals. during this period gave fair or good control of a moderate infestation. Timing did not appear to be of critical importance, as the insecticide retained its effectiveness fairly well and also killed larvae that had entered the fruits several days before the spray was applied. Similar results were obtained by growers, and there were no unusual increases in phytophagous mites or decreases in beneficial forms. In one orchard that was treated with ryania in 1953, natural enemies kept *C. pomonella* under control in 1954, when no treatment was applied. The best control was given by three applications of ryania at intervals of 7–10 days from the beginning of hatching. In Ontario and British Columbia, where *C. pomonella* has two generations a year, six applications of 20 lb. and four of 48 lb. ryania per acre, respectively, in concentrated sprays were effective.

Ryania appeared to have little effect on phytophagous or predacious mites, the predacious thrips, *Haplothrips faurei* Hood and *Leptothrips mali* (Fitch), the predacious Mirid, *Hyaliodes harti* Knight, or *Anthocoris musculus* (Say), and it gave good control of *Spilonota ocellana* (Schiff.), *Typhlocyba pomaria* McAtee, and *Neolygus communis novascotiensis* (Knight), but not of *Phenacoccus aceris* (Sign.), in Nova Scotia, was effective against *T. pomaria* and *T. froggatti* Baker, but not *Rhagoletis pomonella* (Walsh), in Ontario and

controlled *Aphis pomi* Deg. and *Eriosoma lanigerum* (Hsm.) in British Columbia. In Nova Scotia it was moderately toxic to *Malacosoma disstria* Hb. and *M. americanum* (F.).

Fox (C. J. S.). **Control of the Pea Aphid with Malathion in Nova Scotia.** —*85th Rep. ent. Soc. Ont. 1954* pp. 40–41, 2 refs. [Guelph, Ont., 1955.]

Treatment of pea plants in Nova Scotia with 24 fl. oz. 50 per cent. malathion emulsion concentrate in 75 gals. water per acre on 19th July, 1954, reduced the average numbers of *Macrosiphum pisum* (Harris) (*pisi* (Kalt.)) from 26 to one per sweep of a standard insect net in three days, after which the population increased gradually. Treatment with 35 lb. 4 per cent. malathion dust per acre on 22nd July reduced it to 0·3 per sweep after one day and afforded control for almost a week longer than the spray, but dusting has disadvantages in Nova Scotia, where unfavourable winds are frequent. Populations did not increase to more than four per sweep in either field before the peas were harvested in late August, and similarly satisfactory results were obtained by growers with malathion sprays. Chemical analysis of the plants 13–15 days after treatment showed no malathion residues, and no differences due to treatment were detected in the tenderness of newly harvested peas or the taste of the canned peas in January 1955. Malathion is therefore considered preferable to DDT, which gives similar control but may leave heavy and persistent residues.

Foott (W. H.). **The Biology of the Adults of** *Hylemya brassicae* **(Bouché) (Diptera: Anthomyiidae).**—*85th Rep. ent. Soc. Ont. 1954* pp. 42–53, 13 refs. [Guelph, Ont., 1955.]

The following is based largely on the author's introduction and summary. Since little was known of the habits of the adults of *Hylemyia brassicae* (Bch.), observations were made in the laboratory and in fields of turnip in Ontario in 1951 and 1952. Winter is passed in the pupal stage, and the pupae transformed to normal, healthy adults under many adverse conditions; it was found that the adults could emerge from a depth of at least 16 inches of soil. Emergence began early in May in the Guelph area; males and females occurred in approximately equal numbers, but males were the more numerous at first.

The greatest lengths of life recorded were 50 days for a female and 37 for a male. Adults survived for up to three days without food or water, and males and females lived for averages of 5–8 and 10–11 days, respectively, when provided with water, 6·6 and 5·7 days with a 39 per cent. sugar solution resembling nectar, and 22 and 33 days with both sugar solution and water. They preferred water to sugar solution when both were provided, and no eggs were laid in its absence, from which it is concluded that they probably live on nectar and water in spring and early summer but on water only in late summer and autumn, when few sources of nectar are available. They did not appear to be particularly attracted to turnip plants.

In the laboratory, the preoviposition period lasted 3–15 days, and eggs were laid under slices of turnip. In the field, they are usually laid in the soil near a cruciferous plant or between the plant stem and the soil. Hot weather increased adult feeding but reduced activity and oviposition, and cool weather reduced all three [*cf. R.A.E.*, A **42** 409]; in a test, one individual became immobilised when the temperature was below 40°F., but survived temperatures of 20–30°F. The flies sought shelter in cool, windy and rainy weather and soon died on hot, humid days.

The generations overlap too much to be accurately distinguished, but there were four population peaks in the Guelph area in 1952. No evidence was obtained of hibernation in the larval or adult stages.

Allen (W. R.), Westdal (P. H.), Barrett (C. F.) & Askew (W. L.). **Control of the Sunflower Maggot,** *Strauzia longipennis* **(Wied.) (Diptera: Trypetidae), with Demeton.**—*85th Rep. ent. Soc. Ont. 1954* pp. 53–56, 3 refs. [Guelph, Ont., 1955.]

Strauzia longipennis (Wied.) was observed in commercial plantings of sunflower [*Helianthus*] in Manitoba for the first time in 1948 and was very abundant in 1951, when it had largely destroyed the pith of 96·4 per cent. of the plants examined. This Trypetid overwinters in the soil in the puparium, and the adult emerges about mid-June. The oviposition period lasts until about mid-July, and the eggs are deposited just beneath the epidermis of the stalk. The larvae hatch a week later and feed in the pith until about the end of August, when they leave the plant and pupate in the soil.

Preliminary tests on control were made with emulsion sprays containing 1 per cent. demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] in 1953 and 1954. Evaluation of the results, on the basis of amount of damage per plant and number of plants injured, showed that spraying with 0·8 fl. oz. per plant on 30th July, when adults had been caged on the plants for ten days, gave 86·5 per cent. protection in 1953. In 1954 three additional treatments were tested. These comprised removing the soil within 3 ins. of the stem to a depth of 2–3 ins. to expose the upper roots, pouring 10 fl. oz. emulsion into each hole and replacing the soil two hours later; immersing three-quarters of one bottom leaf in the emulsion for 22 hours and then severing the leaf from the plant; and dipping all leaves (6–10) except those near the bud in the emulsion and allowing them to dry. Treatments were applied on 20th July, when the adults had been caged on the plants for eight days, and it was calculated that spraying with 3·75 fl. oz. per plant and soil treatment each gave complete protection, soaking a leaf gave 97·5 per cent., and dipping the leaves 55·5 per cent. Examination of untreated plants showed that the eggs had hatched and most of the larvae were in the first instar on the day of treatment. The tunnels characteristic of the feeding of such young individuals were not found when treated plants were dissected, and it is therefore concluded that the larvae were killed in the first instar.

Foott (W. H.). **Phosphorus-32 Labeling of the Adults of the Cabbage Maggot,** *Hylemya brassicae* **(Bouché) (Diptera: Anthomyiidae).**—*85th Rep. ent. Soc. Ont. 1954* pp. 56–61, 5 refs. [Guelph, Ont., 1955.]

In the course of investigations in Ontario on the dispersal of adults of *Hylemyia brassicae* (Bch.), two methods of tagging the flies with radioactive phosphorus (^{32}P) were developed. In 1951, spraying about 40 caged adults with 0·5 millicurie ^{32}P (in phosphoric acid) diluted to 5 cc. with distilled water resulted in counts per minute of 1,200–1,600 after 24 hours, 200–1,600 after a week and 400 after a fortnight, when only one fly survived. In 1952, similar treatment of 50 flies with 0·25 millicurie ^{32}P in 5 cc. resulted in averages of 245 c.p.m. after one day and 75 after 12, when all but two flies were dead. The radioactivity was not removed by washing, and radioactive eggs were laid by some females, indicating that the solution had been absorbed, but as the length of life was reduced and all the flies in a group might not receive sufficient spray, the method was considered unsatisfactory.

About 100 flies that were allowed to feed on a solution of 0·5 millicurie ^{32}P in 100 cc. 7 per cent. sucrose solution from a wick of dental cotton, which was soaked in the solution every day, showed an average of 340 c.p.m. after a week in 1951, and in 1952, when flies were provided with a solution of 0·75–1 millicurie ^{32}P in 100 cc. 5 per cent. sucrose solution daily for 13 days and then with sucrose solution, the average c.p.m. rose from 300 on the second day to 960 on the 12th and fell thereafter to 150 on the 42nd, when only one fly survived. Females developed significantly more radioactivity than males, and some laid radioactive eggs; larvae from the latter showed no radioactivity. As a significant count was obtained within a few days and maintained for a considerable period after feeding with radioactive material ceased, and as there was no apparent effect on survival or oviposition, this method is considered satisfactory.

Muesebeck (C. F. W.). **New reared Braconidae from Trinidad (Hymenoptera).**—*Proc. ent. Soc. Wash.* **57** no. 4 pp. 161–164, 3 figs. Washington, D.C., 1955.

The Braconids described are *Bracon cajani* sp. n., *Apanteles etiellae isolatus*, subsp. n., *Phanerotoma bennetti*, sp. n., and *P. nigripelta*, sp. n. The first three were reared from *Ancylostomia stercorea* (Zell.) on pigeon pea [*Cajanus cajan*], and the last from an unidentified Lepidopterous larva on *Tephrosia*, all in Trinidad. *A. e. isolatus* is also recorded from *Ancylostomia stercorea* in Grenada, British Guiana, Dominica and Virgin Gorda (British Virgin Islands), and *P. bennetti* from it in British Guiana.

Mulla (M. S.). **Two Mymarid Egg Parasites attacking *Typhlocyba* Species in California.**—*J. econ. Ent.* **49** no. 4 pp. 438–441, 8 figs., 10 refs. Menasha, Wis., 1956.

Observations were made in 1953–54 on the two Mymarids found parasitising the eggs of *Typhlocyba* spp. in prune orchards in California [*cf. R.A.E.*, A **44** 242]. *Anagrus epos* Gir. was found to overwinter as a half-grown larva in the eggs of *T. prunicola* Edw. and *T. quercus* (F.); the larva pupates inside the host egg, and the adult emerges through a hole in the bark or leaf tissue in which the egg is situated. Adult emergence was observed from late March to early November, so that there is possibly more than one generation in a single generation of the host. *A. armatus nigriceps* Gir. was less common and was reared only from the summer eggs of *T. prunicola*. Its bionomics apparently resemble those of *A. epos*. In 1953, the summer eggs of *T. prunicola* were heavily parasitised, chiefly by *A. epos*, and the nymphal and adult populations were as a result considerably reduced. The summer eggs increased rapidly in number between late May and mid-July and then declined, and parasitism increased slowly at first, rapidly between 20th June and 20th July and then gradually, until 95 per cent. or more of the few remaining eggs were parasitised in early September. In August and September, when most of the summer eggs have hatched or are parasitised and few overwintering eggs of *T. prunicola* have been deposited, *A. epos* appears to oviposit in the overwintering eggs of *T. quercus*; later it attacks those of *T. prunicola*.

Milliron (H. E.). **Observations on the Alfalfa Weevil in Delaware, 1955.**—*J. econ. Ent.* **49** no. 4 pp. 441–443, 1 ref. Menasha, Wis., 1956.

Observations on the bionomics of *Hypera variabilis* (Hbst.) (*postica* (Gylh.)) on lucerne in Delaware [*cf. R.A.E.*, A **44** 165] were continued in

1955. Comparatively few adults were found in litter taken from lucerne fields on 9th–16th March, indicating low winter survival, and pupae and adults that had been caged under outdoor conditions in October were all dead by 7th March. There was one egg cavity per 6–20 dead lucerne stems in one locality, and the average number of eggs per cavity was 10·5. Newly deposited eggs were not found until mid-March. Low temperatures during the second half of that month retarded egg production and the hatching of overwintered eggs, greatly increased the mortality of eggs and newly hatched larvae, and reduced the viability of eggs that had survived all or part of the winter. Hatching had begun by 16th March in dead stems and by 23rd March in new growth. Larvae were most abundant during the second half of May, as compared with the first half of May in 1953 and late April in 1954, and numbers were greater than in the preceding year. Although temperatures in March may have affected the rate of increase, there appeared to be a more direct correlation between April temperatures and the peak of larval abundance. Attempts to recover *Bathyplectes curculionis* (Thoms.), which had been liberated against the weevil in 1954 [*cf.* **44** 166], were unsuccessful.

Wilson (M. C.), Davis (R. L.), Haws (B. A.) & Thomas (H. L.). **Attractiveness of Sweetclover Varieties to the Sweetclover Weevil.**—*J. econ. Ent.* **49** no. 4 pp. 444–446, 7 refs. Menasha, Wis., 1956.

The following is based on the authors' summary. Investigations carried out in 1953–55 in Indiana and Minnesota showed differences in the amount of injury caused to different varieties of sweet clover [*Melilotus*] by *Sitona cylindricollis* Fhs. None escaped injury, but common white and common yellow sweet clover were consistently the least injured, and the Spanish variety was less damaged than any but these. There were differences in the results for some varieties in the two States; the weevil was more numerous in Minnesota than in Indiana, the time of infestation differed, and it is possible that differences in plant development and in the time of year at which the plants were examined also affected the results.

Vanderzant (E. S.) & Reiser (R.). **Studies of the Nutrition of the Pink Bollworm using purified Casein Media.**—*J. econ. Ent.* **49** no. 4 pp. 454–458, 1 graph, 13 refs. Menasha, Wis., 1956.

The following is based on the authors' introduction and summary. As the rate of growth of larvae of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) and the number that pupated when reared on synthetic media containing albumen as the source of protein were low [*cf. R.A.E.*, A **45** 91], a casein medium was substituted. Larvae reared on this developed in the normal time and gave rise to adults that laid fertile eggs. In an attempt to produce larger and more rapidly developing larvae and to reduce the number entering diapause, it was found that a reduction in the fat content of the diet from 2 to 0·25 per cent. increased the pupation rate and decreased the number of resting larvae, whereas the omission of cystine and glycine increased the frequency of diapause. An increase in vitamin content or the addition of yeast extract, or nucleic acid and thymine, had no effect on the growth rate or size of the larvae. The omission of fat and choline prevented larval development, and when cholesterol was omitted, many larvae pupated, but the pupae were abnormal unless it was replaced by ergosterol, sitosterol or stigmasterol. Media containing 0·01–0·3 per cent. cholesterol produced larvae of similar size with a similar rate of development. Larval size was

increased and the growth and pupation rates accelerated when the content of sucrose in the basic medium was reduced and that of Wesson's salts increased; the optimum contents of these were found to be 4–6 and 1·2–1·75 per cent., respectively.

Barker (J. S.) & Maughan (F. B.). **Acaricidal Properties of Rohm & Haas FW-293.**—*J. econ. Ent.* **49** no. 4 pp. 458–460, 1 ref. Menasha, Wis., 1956.

Rohm & Haas FW-293 [1,1-bis(p-chlorophenyl)-2,2,2-trichloroethanol] having proved very toxic to all stages of *Tetranychus telarius* (L.) at 10–50 parts per million in sprays in the laboratory and harmless to the foliage of susceptible plants at 0·5–1 lb. per 100 U.S. gals. in the greenhouse, its value for the control of *T. telarius* and *Metatetranychus ulmi* (Koch) in the field was tested on apple in Pennsylvania. Emulsion or wettable-powder sprays containing 0·4 or 0·8 lb. actual compound per 100 U.S. gals., applied against a mixed population of the two species on 15th June, reduced the average numbers of living mites during the next 40 days from over 2,500 to 30–77 per 100 leaves, and similar sprays containing 0·2 lb. reduced them to about 140 and 230, respectively; all sprays gave complete initial mortality. In either form, the highest concentration gave satisfactory control for 9–12 weeks (the duration of the test), whether or not the trees had received a dormant-oil spray, and the medium concentration was as effective as this after dormant oil. The medium concentration without dormant oil and the lowest concentration with or without it maintained control for 6–8 weeks, the lowest concentration giving longer protection when preceded by dormant oil. The average number of applications necessary to give adequate control for the season rose from one for the highest concentration in emulsion form, with or without prior dormant-oil treatment, to two for the other concentrations in either form, without oil treatment. Single applications at 0·4 lb. per 100 U.S. gals. in emulsion sprays on 27th May, 29th June or both all gave adequate protection. The results of oral and percutaneous applications to rats and rabbits indicated that the compound was relatively harmless to mammals.

Finlayson (D. G.). **Maggots and Puparia in Stems and Seed Balls of Onions at Harvest.**—*J. econ. Ent.* **49** no. 4 pp. 460–462, 2 figs., 1 ref. Menasha, Wis., 1956.

As puparia of *Hylemyia antiqua* (Mg.) were found in 1953 at Kelowna, British Columbia, in onion seed that had passed through the mechanical processes of threshing and cleaning, investigations were made in 1954. Seed heads from plants that had received no insecticidal treatment were cut with 0, 1 or 3 ins. stem attached and put in sacks, half of which were allowed to come in contact with onion plants or the ground in onion fields and the rest prevented from doing so, and these were examined before and after threshing, together with samples of commercial threshed and cleaned seed. Larvae or puparia of five species of Diptera, *H. antiqua*, *H. cilicrura* (Rond.), *Eumerus* (*Paragopsis*) *strigatus* (Fall.), *Fannia canicularis* (L.) and *Syrphus* sp. (presumably a predator of Aphids or Coccids) were obtained, and a Braconid parasite, *Aphaereta* sp. near *A. auripes* (Prov.), emerged from undersized puparia of *H. antiqua*. Examination of the seed heads showed no association between the length of stem retained and the numbers of larvae and puparia. Contact with plants or the ground made little difference, but there was a marked reduction in the number of insects found after threshing and cleaning. Nearly twice as many adults emerged from puparia not

subjected to threshing, whether the insects were in diapause or not. The larvae of *Hylemyia* spp. were found to have fed and pupated in the enlarged end of the stalk supporting the seeds. When seed containing puparia was given the standard insecticidal treatment with wettable 50 per cent. dieldrin or DDT [*cf. R.A.E.*, A **44** 34], dieldrin prevented any emergence of adults and DDT gave complete kill within two days of all those that did emerge.

MADSEN (H. F.). **Codling Moth Control on Pears 1954–55.**—*J. econ. Ent.* **49** no. 4 pp. 467–470, 7 refs. Menasha, Wis., 1956.

In view of reports of the development of resistance to DDT in *Cydia* (*Carpocapsa*) *pomonella* (L.) in the eastern United States [*cf. R.A.E.*, A **44** 384, etc.], substitute materials were compared with this insecticide against the larvae on pear in California, where the normal treatment is an application of DDT at petal-fall followed by a second 21–30 days later and a third on late varieties. Wettable powders were used unless otherwise stated.

In 1954, spray applications were made on 19th and 26th April, 17th May and 29th June, and 30 lb. ryania, 10 lb. 50 per cent. DDT or methoxy-DDT (methoxychlor) and 15 lb. 25 per cent. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] in 500 U.S. gals. spray per acre resulted in less than 0·5 per cent. infested fruits at harvest, and 30 lb. lead arsenate in 2·1 per cent. Diazinon also gave excellent control of *Pseudococcus maritimus* (Ehrh.), and lead arsenate and ryania were more effective against this mealybug than DDT or methoxy-DDT. Ryania gave complete and Diazinon good control of *Lithocolletis* sp., but this leaf-miner was not affected by DDT, methoxy-DDT or lead arsenate. *Metatetranychus ulmi* (Koch) and *Tetranychus telarius* (L.) were present, and it was necessary to add an acaricide to all the insecticides applied in June, except Diazinon, which kept the mite population low throughout the season. There were fewer mites on trees sprayed with ryania or lead arsenate than on those receiving DDT or methoxy-DDT.

Reports were received in 1954 of two cases of possible DDT resistance, but bait-trap records and spray tests in 1955 indicated that faulty timing of sprays was responsible for the increased fruit damage, the first flight of moths being unusually late. In one of these orchards, sprays of 14·2 lb. 50 per cent. DDT or 25 per cent. Diazinon and 42·6 lb. ryania in 750 U.S. gals. per acre, on 9th May, 13th June and 7th July, reduced the percentages of infested fruits at harvest to 0·5, 3·5 and 1·7, respectively, as compared with 60 per cent. after DDT treatment in 1954, but it was necessary to add an acaricide to the last applications of DDT and ryania to control *T. telarius*. In the other, four applications, on 6th April, 2nd May, 8th June and 12th July, of 9·2 lb. 50 per cent. DDT or 22·2 lb. ryania in 500 U.S. gals. per acre resulted in less than 0·5 per cent. infested fruits at harvest, whereas 11·5 lb. 25 per cent. Diazinon resulted in 6 per cent. An acaricide was required in the last ryania spray and the last two DDT sprays for the control of *T. telarius*. Ryania gave excellent and Diazinon good control of *Lithocolletis*, but DDT was ineffective. In a third, very heavily infested orchard, sprays of 11·2 lb. 50 per cent. DDT or 33·6 lb. ryania in 560 U.S. gals. per acre on 24th May, 28th June and 18th July reduced the percentage infestation at harvest from over 59 to less than 1; 11·2 lb. 25 per cent. Stauffer 1303 (O,O-diethyl S-p-chlorophenylthiomethyl phosphorodithioate) or 50 per cent. DDD (TDE) reduced it to 2·3 and 4·6, respectively, and 11·2 lb. 25 per cent. Diazinon and 11·2 U.S. pints 25 per cent. Diazinon emulsion concentrate reduced it to 4·8 and 6·3 per cent., which was not adequate for commercial control. Lead arsenate gave poor results.

Ristich (S. S.). **Mass Rearing and Testing Techniques for** *Typhlodromus fallacis* **(Gar.).**—*J. econ. Ent.* **49** no. 4 pp. 476–479, 4 figs., 10 refs. Menasha, Wis., 1956. **Toxicity of Pesticides to** *Typhlodromus fallacis* **(Gar.).**—*T. c.* pp. 511–515, 11 refs.

In view of the current interest in the effects of insecticides and other toxicants on predacious mites, a method was developed in Ohio for rearing *Typhlodromus fallacis* (Garman) in the greenhouse to provide material for toxicity tests. It is described in the first of these papers, and is probably applicable to similar species. *Tetranychus telarius* (L.) was reared on bean plants to provide prey, and *Typhlodromus* was colonised on young infested plants in suitable numbers. The greenhouse was shaded in summer, and colonies were maintained for 3½ years. Methods of testing toxicants on *T. fallacis* are reviewed, and one in which the mobile stages are first eliminated is described.

In the second paper, the results are given of tests of the toxicity of numerous compounds to *T. fallacis*, and the following is based on the author's summary of them. Of the various insecticides tested, the most toxic were parathion, malathion, DDT, DDD (TDE) and methoxy-DDT (methoxychlor), and the least toxic were ryania, dieldrin and lead arsenate, though the arsenate seemed to interfere with egg production. Of the acaricides, DMC [1,1-bis-(p-chlorophenyl)ethanol] was the most toxic, and Chlorobenzilate [ethyl 4,4′-dichlorobenzilate], Rohm & Haas FW-293 [1,1-bis(p-chlorophenyl)-2,2,2-trichloroethanol] and ovex [p-chlorophenyl p-chlorobenzenesulphonate] were moderately poisonous; the last two were also ovicidal. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] was the least toxic, but was ovicidal and persistent in its effects at high dosages. Of the fungicides, sulphur was the most toxic to the eggs and immature stages and phenyl mercuric triethanol ammonium lactate to the adults; glyodin [2-heptadecyl glyoxalidine acetate] and captan [N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide] were moderately toxic, and ferbam [ferric dimethyldithiocarbamate] gave erratic results, but showed evidence of being harmful to the eggs and young immature mites.

Fronk (W. D.) & Peterson (L. E.). **Wireworm Control in Iowa Sweet Potato Fields.**—*J. econ. Ent.* **49** no. 4 pp. 479–481, 1 ref. Menasha, Wis., 1956.

Sweet potatoes grown under irrigation in the coarse sandy soil of the Muscatine Island area of Iowa are severely injured by wireworms of the genus *Melanotus*, and investigations were carried out in 1950–54 on the protective effect of various treatments with soil insecticides.

When applied in the transplant water, chlordane and Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)] at 1 lb. and aldrin, dieldrin and lindane [almost pure γ BHC] at 0·5 lb. per acre in wettable powders considerably reduced the numbers of damaged tubers, but all except dieldrin reduced the yield; 0·5 lb. aldrin or dieldrin and 1 lb. chlordane were much less effective in reducing the damage when applied in the fertiliser, but there was no difference between yields. Aldrin appeared to be equally effective at 0·25–1 lb. per acre when added to the transplant water in emulsions or wettable powders, and 0·125 lb. aldrin and 0·25 lb. endrin per acre, in emulsion concentrates, practically eliminated wireworm damage in 1954 and increased the yield from 16·8 to about 17·5 lb. per plot 0·05 acre in size.

In a test of fumigants, ethylene dibromide applied at a rate of 0·5 U.S. pint per 100 ft. of row at a depth of 6–7 ins. in the plant row, a month before the slips were transplanted, reduced wireworm damage by only 12 per cent.

and did not affect the yield; similar treatment with D-D mixture [1,3-dichloropropene and 1,2-dichloropropane] reduced the damage by 33 per cent., but the yield was seriously affected.

Siakotos (A. N.). **Package Exposure to continuously vaporized Lindane.** —*J. econ. Ent.* **49** no. 4 pp. 481–484, 6 refs. Menasha, Wis., 1956.

The packages in which dry foodstuffs are stored do not always protect them from infestation by insect pests [*cf. R.A.E.*, A **43** 45; **45** 159], and continuous vaporisation of γ BHC as lindane has been used to prevent attack [**42** 164, etc.]. The investigations described were carried out to determine the extent to which packages of various sorts protected the contents from contamination with the insecticide, and the following is substantially the author's summary of the work.

Various foods in packages were exposed to γ BHC vaporised continuously at the rate of about 1 gm. per 16,240 cu. ft. per 24 hours for periods of up to four months, and then analysed. Penetration of the vapour occurred mainly in the upper half of the packages when these were resting on a horizontal surface and was markedly affected by the efficiency with which they were sealed. Commercial packages of boxboard, kraft paper, cellophane, glassine or aluminium foil all failed to resist penetration completely, but some materials noticeably reduced it, boxboard, kraft paper, two layers of cellophane, aluminium foil laminated to paper, boxboard with a laminated lining paper and boxboard with a glassine lining being progressively less effective.

O'Brien (R. D.). **The Inhibition of Cholinesterase and Succinoxidase by Malathion and its Isomer.**—*J. econ. Ent.* **49** no. 4 pp. 484–490, 8 graphs, 26 refs. Menasha, Wis., 1956.

Malathion [O,O-dimethyl S-(1,2-bis(ethoxycarbonyl)ethyl) phosphorodithioate] is widely used as an insecticide because it is less toxic to mammals than other organophosphorus compounds. It isomerises on heating, and its *in vitro* anticholinesterase activity, which is low, is increased by this process [*cf. R.A.E.*, A **41** 358]. Further studies on the isomerisation of the compound by heat showed that, except under very mild or very severe conditions, two fractions are produced, a brown supernatant liquid insoluble in water but soluble in organic solvents, and a hard whitish glassy solid that is insoluble in organic solvents but dissolves with crackling and heat on addition of water. The solid was produced in amounts that increased with the severity of heat treatment; its ability to inhibit human plasma cholinesterase was low and about equal to that of malathion, which is not soluble in water. The liquid fraction, here termed isomalathion, was found to contain a much more potent inhibitor, but intravenous injection of 50 μg. per gm. caused no symptoms in mice. To estimate its stability, the rate of loss of anticholinesterase activity was studied, and its half-life in 50 per cent. ethanol at 25°C. [77°F.] was found to be about 45 hours. Infra-red spectra of malathion, isomalathion and the solid product supported the hypothesis that isomalathion is produced by an interchange between the double-bonded sulphur of the malathion molecule and an oxygen atom of one of the methoxy groups [*cf. loc. cit.*]. The solid appeared to be a mixture of breakdown products, including anhydrous phosphoric acids.

The mode of action of malathion on insects was studied by observing its effects on *Periplaneta americana* (L.). Its LD50 on injection into adult male cockroaches was 8·4 μg. per gm. body weight, and that of its isomer about 60 μg. The symptoms of malathion poisoning resembled those usually produced by organophosphates, but the ataxic phase set in rather rapidly

(within an hour) and was unusually prolonged, so that some cockroaches into which malathion had been injected at 10 μg. per gm., though moribund, still showed intermittent tremors after five days, and a similar condition persisted for four days even after doses of 100 μg. per gm. None of the insects recovered, however. In contrast, TEPP [tetraethyl pyrophosphate] caused death within 5–10 minutes. Injection of malathion into *Periplaneta* nymphs caused no changes in respiration. The extent to which the cholinesterase was inhibited in the nerve cords of treated cockroaches was lower five days after treatment than five hours after it, when it was comparable with that caused by TEPP at suitable levels. A further test in which malathion was injected at 50 μg. per gm. showed that the percentage inhibition fell from 61 after two hours to 22 after one day, after which it remained fairly constant for a further three days.

These results suggested that malathion acts primarily on enzyme systems other than cholinesterase, and as it is a derivative of succinic acid [*cf.* **41** 3], its effect on succinoxidase, an enzyme concerned in carbohydrate metabolism, was studied. When house-flies (*Musca domestica* L.) were treated topically with 27 μg. malathion per gm. and frozen after intervals of up to 50 hours (the time required for 50 per cent. mortality), cholinesterase inhibition was at first strong (about 98 per cent.) but fell to about 55 per cent. by the time the insects began to die. Succinoxidase inhibition was only slight (16 per cent. initially). As it is not known whether the activity of these enzymes was affected by the death of the insects and subsequent exposure to normal temperature, flies were killed in three ways and exposed to room temperature for various periods up to three days. In all cases, the succinoxidase level fell with time, but the cholinesterase level remained fairly constant. In *in vitro* tests, isomalathion was a stronger inhibitor than malathion of human serum and erythrocyte cholinesterase, house-fly cholinesterase, mouse liver succinoxidase and house-fly succinoxidase. TEPP did not inhibit rat liver succinoxidase. These results support the view that malathion kills by an anticholinesterase action, though the *in vivo* findings were against it. However, in the latter, total cholinesterase activity was studied, and an increase in this at death might mask the occurrence of a different pattern at a localised and important site of the enzyme. Succinoxidase inhibition was apparently not the cause of death.

Armitage (H. M.). **The Khapra Beetle Problem in California.**—*J. econ. Ent.* **49** no. 4 pp. 490–493. Menasha, Wis., 1956.

Mendenhall (W. T.). **Report on the Khapra Beetle Program in Arizona.** —*T. c.* pp. 508–511.

Notes are given in these two papers on the course of the outbreaks of *Trogoderma granarium* Everts on stored products in California and Arizona, respectively [*cf. R.A.E.*, A **44** 445, etc.], and on early attempts at control or the limitation of spread, with details of the methods ultimately developed for eradication by fumigating entire warehouses, inside and out, with methyl bromide [*cf.* **45** 259], the difficulties encountered, the precautions necessary, and the results obtained by late 1955, when eradication from both States was considered possible.

Wilson (J. W.). **Corn Earworm Populations on Sweet Corn in central Florida during the growing Seasons of 1954 and 1955.**—*J. econ. Ent.* **49** no. 4 pp. 493–495, 1 fig., 6 refs. Menasha, Wis., 1956.

Surveys of the seasonal abundance and distribution of eggs of *Heliothis zea* (Boddie) and of infested ears in fields of sweet maize were made in two

districts in central Florida during the growing seasons of 1954 and 1955. In the vicinity of Sanford, populations were low at the beginning of the season, gradually increased as the season advanced, and were much higher at the margins than in other parts of a field, whereas near Zellwood, they were very low throughout the growing season. In this district, which is in a peat-soil area [*cf. R.A.E.*, A **44** 239], preferred food-plants are absent during autumn and winter, and the average temperatures during cold periods are lower than at Sanford; these factors tend to reduce the early populations, and there is a large acreage under sweet maize, which probably leads to dispersion of the population throughout the growing season.

Cartier (J. J.) & Painter (R. H.). **Differential Reactions of two Biotypes of the Corn Leaf Aphid to resistant and susceptible Varieties, Hybrids and Selections of Sorghums.**—*J. econ. Ent.* **49** no. 4 pp. 498–508, 5 figs., 15 refs. Menasha, Wis., 1956.

The following is substantially the authors' summary. Two biological races of *Aphis* (*Rhopalosiphum*) *maidis* Fitch, termed biotypes KS-1 and KS-2, were discovered on sorghum in Kansas in 1954. The second had a greater survival capacity on varieties of sorghum resistant to *A. maidis* and produced heavier adults under comparable conditions, but there were no morphological differences between them. The comparative resistance of sorghums to them was analysed by measuring separately, in the greenhouse, the mechanisms of preference (or non-preference) and antibiosis [the unfavourable effects of a resistant food-plant]; plant tolerance of infestation was not studied. In measuring preference in large groups of plants, the basis of comparison was the number of infestations per plant. In leaf cuttings of individual plants mounted in plastic boxes, the pattern of distribution of winged Aphids on the cuttings after one hour was the measure of the preference qualities of the plants. In measuring antibiosis in large groups of plants, the basis of comparison was the actual number of Aphids produced per plant during a given period, following a repeated initial infestation of each plant. On individual plants, antibiosis was measured by the main increase (Aphids per day) of the progeny of single viviparous females caged on the plants.

In 50 varieties, hybrids and selections of sorghums, involving 5,000 plants, preference was a part of the inherited qualities that remained relatively constant under varying intensities of infestation. Non-preference, as observed in the F_1 hybrid of a cross between White Martin (preferred) and Piper 428-1 (non-preferred) behaved like a dominant character. The average for the F_2 generation was intermediate between the parents in reaction to the Aphids. There were in White Martin some factors which, within a test period of one hour, attracted and stimulated the females of both biotypes to produce young, and in Piper 428-1 some that repelled and almost totally prevented reproduction in the same time. The antibiosis of Piper 428-1 behaved as a dominant character in the F_2 and F_3 hybrid populations including it. Non-preference in F_2 genotypes and standard varieties appeared to be related to antibiosis either physiologically or genetically or both. The expression of antibiosis in reducing the fecundity of biotype KS-1 behaved as a complete dominant in Piper 428-1, partial dominant in the F_1 generation of crosses including it, and recessive in White Martin; in reducing the weight of the adults, the character appeared to be expressed as dominant in Piper 428-1, partly dominant in the F_1 hybrids, and recessive in White Martin. The expression of antibiosis in reducing the fecundity of biotype KS-2 appeared to be partly dominant in Piper 428-1 and recessive in the F_1 hybrids and White Martin; in reducing the weight of the adults, the

expression appeared to be partly dominant in Piper 428-1 and the F_1 plants and recessive in White Martin. The antibiosis of Piper 428-1 affected biotype KS-1 by reducing the weight of the females as soon as they fed on it and preventing the maturing of their progeny, if any. Biotype KS-2 was less affected. In the progeny of Piper 428-1, biotype KS-1 was not less affected than KS-2.

There was a segregation for ability of the plants to suppress fecundity and reduce Aphid weight in the F_2 generation. The antibiosis of the resistant parent and the susceptibility of the other parent were recovered in several F_2 plants. As observed from the progenies of single viviparous females caged on the plants, the resistant genotypes reduced the fecundity of the females and the weight of the adults in the Aphid progenies. The susceptible genotypes favoured a rapid rate of reproduction and increased the weight of the adults in the Aphid progenies.

Aphids of both biotypes reared separately on the heads of White Martin sorghum were heavier and their rate of reproduction was two or three times as high as that of Aphids reared on lower leaves of the same plants. Antibiosis at least partly inhibited wing production in the progeny of apterous females.

Analysis of resistance in the sorghums studied indicated that six mechanisms of either preference or antibiosis were responsible for the differences found. These mechanisms appeared to be either dominant or partly dominant in their expression, because the Aphid biotypes showed differential reactions on the same food-plants. The non-discrete segregation in the F_2 plants and the F_3 lines suggests a multiple-factor hypothesis.

Chada (H. L.). **Biology of the Winter Grain Mite and its Control in small Grains.**—*J. econ. Ent.* **49** no. 4 pp. 515–520, 3 figs., 15 refs. Menasha, Wis., 1956.

The following is based largely on the author's summary. *Penthaleus major* (Dugès), of which the distribution is reviewed and all stages described, damages autumn-sown small grains in north-central and central Texas. Infested fields have a greyish or silvered appearance, caused by the removal of sap and chlorophyll from the leaves, with consequent reductions in forage for autumn and winter grazing and in yields of grain at harvest. The mites hatch in the autumn from aestivating eggs and are present throughout the winter. Males were not observed. Low temperatures and adequate moisture are necessary for development, and the mites die with the approach of hot weather in spring. There are two generations a year, and most of the feeding is done at night or on cloudy days. Small grains or grasses are the preferred food-plants, but the mites have also been observed on vegetable crops and weeds. Wheat, oats and barley were equally favoured.

Infestation is spread by the transport of aestivating eggs by strong winds or on grain stubble and leaves, other débris, or soil during the movement of farm machinery from field to field. Fields continuously under small grains are the most heavily infested, and crop rotation is therefore recommended.

In preliminary tests in 1952, treatment with 0·25 lb. parathion or malathion and 0·5 lb. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] in 10 U.S. gals. spray per acre gave 100, 92 and 81 per cent. control, respectively, in three days. In emulsion sprays used at 10 U.S. gals. per acre in 1953, applications of 0·25 lb. parathion, Metacide [methylparathion and parathion] or TEPP [tetraethyl pyrophosphate] to oats 3 ins. high on 28th January, of 0·125 lb. parathion or TEPP, 0·25 lb. Metacide or malathion, and 0·5 lb. Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] to oats 5 ins. high on 3rd February, and of 0·25 lb. parathion

to wheat 12 ins. high on 23rd March gave at least 98 per cent. control, and Aramite, ovex [p-chlorophenyl p-chlorobenzenesulphonate] and Sulphenone [p-chlorophenyl phenyl sulphone] gave good results at 0·33–0·5 lb.; 0·25 lb. Chlorobenzilate [ethyl 4,4′-dichlorobenzilate] was ineffective. In fields sprayed by growers, one application of 0·25 lb. parathion or TEPP per acre gave seasonal control of the mite, and either of these acaricides or malathion at the same dosage is recommended.

Garman (P.). **Further Study of Spray Combinations for Control of Apple Pests in Connecticut.**—*J. econ. Ent.* **49** no. 4 pp. 521–523. Menasha, Wis., 1956.

Investigations in Connecticut on the general effects of various combinations of insecticides and fungicides applied in sprays to apple were begun in 1952–53 [*cf. R.A.E.*, A **43** 306] and continued in 1954–55. The spray combinations compared in each of the four years are given, and the results are reviewed with special reference to 1954–55. The best insecticide for control of *Conotrachelus nenuphar* (Hbst.) was methoxy-DDT (methoxychlor); dieldrin in early applications was no better, though somewhat cheaper. An outbreak of *Cydia* (*Carpocapsa*) *pomonella* (L.) in 1955 was best controlled by the chlorinated hydrocarbons [*cf. loc. cit.*]; ryania gave promising results in 1954 and 1955. Applications of dieldrin in the early sprays and of lead arsenate in those after the calyx stage gave good control of *Hoplocampa testudinea* (Klug) in 1955. In 1954, *Anuraphis roseus* Baker was injurious in all plots sprayed with lead arsenate, even though malathion was added, whereas *Eriosoma lanigerum* (Hsm.) became more abundant in the plot receiving a mixture of methoxy-DDT, DDD (TDE), captan [N-(trichloromethylthio)-4-cyclohexene-1,2-dicarboximide] and glyodin [2-heptadecyl glyoxalidine acetate] than in any other; in 1955, a combination of malathion with captan and one of DDT, parathion and glyodin with captan appeared to give the best Aphid control, indicating that the phosphates were fairly effective except when used with lead arsenate. *Tetranychus telarius* (L.) and *Metatetranychus ulmi* (Koch) did not increase after treatment with sprays of ryania and glyodin in 1954 and 1955, and no acaricide was needed in 1955 on trees treated with malathion and captan, with Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], captan and glyodin or with DDT, parathion, captan and glyodin; in contrast, mites became numerous on trees receiving methoxy-DDT and captan, and acaricides were required on plots treated with lead arsenate and captan, with or without dieldrin in the early sprays. The highest proportion of undamaged fruits was given by a mixture of methoxy-DDT, DDD, captan and malathion in 1954 and by one of methoxy-DDT and captan in 1955.

Shirck (F. H.) & Douglass (J. R.). **Experiments on Control of the Onion Thrips in Idaho.**—*J. econ. Ent.* **49** no. 4 pp. 526–529, 3 figs., 7 refs. Menasha, Wis., 1956.

Experiments on the control of *Thrips tabaci* Lind. on onion in southern Idaho were carried out from 1945 to 1952, and some of the earlier results have already been noticed [*cf. R.A.E.*, A **38** 113]. In 1948–49, sprays were applied 2–3 times at 150–200 U.S. gals. per acre in July to onions grown for bulbs; 2·5 U.S. quarts 25 per cent. DDT emulsion concentrate per 100 U.S. gals. gave better control in 1949 than 2 lb. 50 per cent. wettable DDT, and 1 lb. 15 per cent. wettable parathion and 1·3 U.S. quarts 50 per cent.

toxaphene emulsion concentrate were just as effective. The addition of HETP [hexaethyl tetraphosphate], parathion or, in one year but not the other, nicotine sulphate to the DDT suspension improved its effectiveness, but did not seem justified in view of the low thrips populations present. Treatment with a chlordane emulsion spray was fairly effective in 1949, and 1·5 lb. DDT or dieldrin or 2 lb. toxaphene in 9·75 U.S. gals. spray per acre, applied from a turbine blower, or 0·75 lb. dieldrin in 25–50 U.S. gals. per acre, from a gear-pump sprayer, were at least as effective in 1951 as the same materials applied in 100–150 U.S. gals. per acre with a tractor-driven sprayer; dieldrin tended to be more effective than toxaphene or DDT. Dusts of DDT or toxaphene applied in June 1949 and July 1950 under a muslin trailer were effective, but more insecticide was needed than for sprays. The only increases in yield resulted from the chlordane and toxaphene sprays and the DDT and toxaphene dusts.

On seed crops, a DDT aerosol, applied twice to the bagged seed umbels in July 1945, controlled the thrips and gave a significant increase in yield, but dusts of aldrin, BHC, chlordane, DDT, lindane [almost pure γ BHC], nicotine sulphate, parathion, toxaphene or Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane], applied to the plants 2–3 times under a portable cloth canopy resulted in no increases in 1947–51, though all but Dilan gave good control of the thrips.

Hofmaster (R. N.). **Flea Beetle Control on Irish Potatoes in eastern Virginia.**—*J. econ. Ent.* **49** no. 4 pp. 530–533, 2 figs., 4 refs. Menasha, Wis., 1956.

As DDT, which had given good control of *Epitrix cucumeris* (Harris) on potato on the Eastern Shore of Virginia in 1947, was reported to be unsatisfactory in 1953, other insecticides were compared with it in 1954 in foliage sprays and dusts applied on 20th and 27th May and 7th June. Aldrin, dieldrin, Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane], endrin and heptachlor, applied at 0·5 lb. in 100 U.S. gals. emulsion spray per acre were more effective than similar sprays of DDT, and dusts of 1·5 per cent. dieldrin or Dilan, 2 per cent. endrin, and 2·5 per cent. aldrin or heptachlor were more effective than a regular 5 per cent. DDT dust, as were also dusts of 1 per cent. impregnated DDT with 4 per cent. regular DDT and 1 per cent. parathion with 5 per cent. DDT. In general, sprays were slightly superior to dusts, but the insecticides showed the same order of effectiveness in the two forms. None of the treatments significantly affected the yield.

In 1955, soil treatment with 2·5 lb. aldrin or heptachlor per acre a fortnight before planting, alone or followed by foliage sprays of the same materials at 0·5 lb. per acre on 25th May and 7th, 14th and 21st June, and foliage sprays of 0·2 lb. dieldrin per acre all caused more than 94 per cent. reduction in foliage injury and resulted in 74–88·5 per cent. increases in yield, owing to increase in tuber size. The soil treatments greatly reduced tuber injury. In another test, spraying the foliage with 0·5 lb. DDT, heptachlor or aldrin, 0·15 lb. endrin, 0·2 lb. dieldrin or 1 lb. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] in 100 U.S. gals. water per acre on the same dates reduced the foliage damage by about 90 per cent. or more and increased the yields by 45·2–67·3 per cent.; DDT appeared to give the least insect control, but the difference was not significant.

It is concluded that DDT is still fairly effective against the flea-beetle provided that applications are correctly timed, but that other materials are superior to it.

Carman (G. E.) & Lindgren (D. L.). **Evaluation of Parathion in California Red Scale and Yellow Scale Eradication Programs.**—*J. econ. Ent.* **49** no. 4 pp. 534–539. Menasha, Wis., 1956.

In several fairly isolated and largely uninfested *Citrus*-growing areas of southern and central California, the intensive suppression or eradication of infestations of *Aonidiella aurantii* (Mask.) and *A. citrina* (Coq.) is undertaken as the most practical means of control. Standard methods are used to detect infestations and to prevent the establishment of fresh ones, but eradication is costly, involving repeated treatment of infested trees and those round them at short intervals by fumigation with hydrogen cyanide or spraying with oil emulsion, the character, number and order of treatments being determined by the time of year, extent of infestation, degree of insect resistance to HCN and tree tolerance. Parathion at 2·5 lb. 25 per cent. wettable powder per 100 U.S. gals. was therefore introduced in 1951–52 into schedules of three treatments against *A. aurantii* in Riverside County, to determine whether it would increase the effectiveness and flexibility of the programme and reduce phytotoxic effects; the three treatments were applied in various sequences, oil not more than once, for fear of injuring the trees, but parathion and HCN each 1–3 times. The results indicated that oil emulsions did not give the best control; a parathion spray appeared to be the most desirable initial treatment and was preferably followed by two fumigations with HCN or a second parathion spray and a fumigation, in that order. The combination of parathion sprays with HCN fumigations appeared to give better results than the exclusive use of either. Somewhat similar results were obtained against *A. citrina* in Tulare County, where parathion was used at 2 lb. wettable powder per 100 U.S. gals. and the schedules comprised two or three insecticide applications. Oil emulsion gave relatively poor results, and parathion proved the best initial treatment and was best followed by fumigation with HCN.

In both areas, an eradication schedule of two fumigations and a spray of oil emulsion gave very poor results, and it is concluded that it is desirable to substitute parathion for the oil spray and possibly also for one HCN fumigation.

Connell (W. A.). **Control of Larvae infesting Sweet Corn Ears.**—*J. econ. Ent.* **49** no. 4 pp. 539–542, 1 fig., 9 refs. Menasha, Wis., 1956.

In August 1955, small replicated plots of sweet maize at Georgetown, Delaware, were treated with a spray of 3 U.S. quarts 25 per cent. DDT emulsion concentrate and 8 U.S. quarts mineral oil in 22 U.S. gals. water per acre, three times in ten days, beginning when 10 per cent. of the ears were in silk, for the control of *Heliothis zea* (Boddie). Some plots were also treated against *Carpophilus lugubris* Murr. by adding 2 U.S. quarts 25 per cent. aldrin emulsion concentrate or 3 U.S. quarts 25 per cent. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] per acre in the last spray application or by applying 1 U.S. pint 50 per cent. malathion emulsion concentrate per acre in the last application and, alone, four days later.

After no treatment, and treatment with DDT and DDT with malathion, aldrin and Diazinon, respectively, the percentages of ears injured by *H. zea* were 97, 60, 63, 53 and 43 and the lengths trimmed from the ears to remove the injured portions were 1·15, 0·48, 0·51, 0·6 and 0·21 inches; the percentages of ears injured by *C. lugubris* were 100, 97, 97, 20 and 23, the lengths trimmed were 1, 1·72, 0·63, 0·25 and 0·13 inches, and the numbers of *Carpophilus* larvae per ear were 18, 22, 10, 0·6 and 0·4.

Beckham (C. M.). **The Effectiveness of several Insecticides and Formulations in the Control of Seed Weevils on Crimson Clover.**—*J. econ. Ent.* **49** no. 4 pp. 542–544, 3 refs. Menasha, Wis., 1956.

Hypera meles (F.) and *H. nigrirostris* (F.) have been numerous on crimson clover [*Trifolium incarnatum*] in two counties of northern Georgia for several years; the two species occur on the clover heads together, the larvae and adults being present during the period of bloom and seed development, but *H. nigrirostris* is slightly the earlier. In tests on the control of these weevils in 1955, insecticides were applied in granular form with fertiliser on 15th April or in sprays or dusts on 27th April. In granules, 2·5 lb. actual heptachlor, dieldrin or aldrin in 800 lb. fertiliser per acre gave good reductions in the numbers of larvae of both species, apparently through control of the adults, whereas 10 lb. toxaphene gave barely significant reductions of *H. nigrirostris* and none of *H. meles*. Parathion at 0·3 lb., dieldrin at 0·45 lb., heptachlor and aldrin at 0·75 lb. and malathion, chlordane and toxaphene at 1·2, 1·5 and 6 lb., respectively, in 30 lb. dust per acre and dieldrin, endrin and Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate] at 0·3, 0·4 and 0·5 lb., Am. Cyanamid 3911 [O,O-diethyl S-ethylthiomethyl phosphorodithioate] and methoxy-DDT (methoxychlor) at 1 lb. and malathion and toxaphene at 1·25 and 2 lb. in 55 U.S. gals. spray per acre all gave significant control of both species, though toxaphene caused the least reduction in numbers of larvae in all cases. Increases in yield of sound seed followed every treatment except that with granular toxaphene, but they were not significant.

Dahms (R. G.), Johnston (T. H.), Schlehuber (A. M.) & Wood jr. (E. A.). **Reaction of Small-grain Varieties and Hybrids to Greenbug Attack.**—*Tech. Bull. Okla. agric. Exp. Sta.* no. T-55, 61 pp., 4 figs., 21 refs. Stillwater, Okla., 1955.

Painter (R. H.) & Peters (D. C.). **Screening Wheat Varieties and Hybrids for Resistance to the Greenbug.**—*J. econ. Ent.* **49** no. 4 pp. 546–548, 2 refs. Menasha, Wis., 1956.

The following is virtually the authors' summary of the first paper. Several hundred varieties and hybrids of small grains were tested for resistance to *Toxoptera graminum* (Rond.) in the greenhouse, insectary and field in Oklahoma in 1947–53. Resistance was determined in the greenhouse in separate tests for preference, tolerance and fecundity and in the insectary from the periods required for the Aphids to kill the plants and the growth made after these were infested. Varieties that showed some resistance in the greenhouse were tested in the field to determine their reaction to natural infestations. Many of the barley varieties showed a high degree of resistance. All highly resistant varieties except two originated in China, Korea or Japan [*cf. R.A.E.*, A **34** 376]. Preliminary data on F_1 and F_2 hybrid populations of crosses between susceptible and resistant varieties indicated that the resistance was inherited. With few exceptions, it appeared to be dominant to susceptibility, and was probably governed by two or more genes. There was no apparent correlation between readily visible morphological characteristics of the barley plant and resistance, although all the resistant varieties studied had long rachilla and rachis hairs. None of the wheat and rye varieties tested showed a high degree of resistance; however, several (especially some durums) were considerably more tolerant than varieties now grown in the hard-winter-wheat area. Plants grown from some "off-type" seed found in one durum variety, Dickinson No. 485 C.I. 3707, showed considerable resistance when tested in a special insectary. Although there was some variation in the reaction of oat varieties to attack, none showed

a high degree of resistance. Two spring varieties that are adapted to Oklahoma conditions were less susceptible than the susceptible Wintok variety used as a check.

The second paper comprises an account of similar tests made in Kansas in 1954–55, in which more than 2,000 strains of wheat were compared with susceptible and resistant varieties (Pawnee and Dickinson) for resistance to *T. graminum*. Most of them were more susceptible than Pawnee, but about 4 per cent. appeared to possess some resistance. In tests of the F_2 population of three hybrids between resistant and susceptible varieties, the proportion of plants surviving infestation (almost one-third) suggested a single factor difference for this type of reaction to the Aphid.

Pence (R. J.). **The Tolerance of the Drywood Termite, *Kalotermes minor* Hagen, to Desiccation.**—*J. econ. Ent.* **49** no. 4 pp. 553–554, 3 figs., 5 refs. Menasha, Wis., 1956.

Although *Kalotermes minor* Hagen prefers a moist environment, it can adapt itself to extremes of humidity and survive under arid conditions [*cf. R.A.E.*, A **38** 368], owing to its ability to seal itself off with the carton that it produces and thus conserve moisture. In attics in southern California, summer temperatures sometimes reach 150°F., but the increase is gradual and the drying of the wood in which the termites live is slow, so that the insects adjust themselves to the change. Moisture absorbed by the timber during the night and the microclimate provided by the termites themselves, deep in their galleries, help them to survive. They are said to be able to exist in wood containing as little as 2·5–3 per cent. moisture.

In the laboratory, termites survived for long periods, both under room conditions and in moisture-saturated atmospheres; if removed suddenly to dry conditions, they crowded together until they had sealed themselves off in a cell to retain moisture, after which they separated and showed normal activity. A sharp change in temperature proved fatal, however, the termites dying when exposed to 130·5°F. if given no opportunity to seek protection. In an experiment in which batches of 120 termites were put in cells in two blocks of well dried pine wood in May 1955 and kept in a desiccator, all were dead by 10th November in one block but one was still living on 9th January 1956 in the other. In two similar blocks kept under room conditions, all were dead by 1st December and all but three on 9th January, respectively, indicating that once the wood was dry and the termites sealed in their cells, they were not affected by external conditions. The survivor from the first pair of blocks was extremely desiccated, but became normal in appearance about 24 hours after imbibing free moisture and was still alive after eight days under saturated conditions.

Secrest (J. P.). **A Laboratory Method for biological Testing of Insecticide Sprays used in Forest Insect Control.**—*J. econ. Ent.* **49** no. 4 pp. 555–556, 2 figs., 1 ref. Menasha, Wis., 1956.

Notes are given on techniques developed in Maryland for using *Periplaneta americana* (L.) as a test insect in evaluating sprays to be applied from aircraft against forest insects. Cockroach nymphs are confined with food in petri dishes or on glass plates that have been sprayed in the field or laboratory, or without additional food on sprayed foliage brought into the laboratory or left outdoors. Mortality counts are made after three days on glass and after six days on foliage. The cockroach has been successfully used in tests of dosage-mortality relations, atomisation, weathering of deposits and spray formulation.

Kring (J. B.). **Dieldrin and Endrin for Control of DDT-resistant Potato Flea Beetles.**—*J. econ. Ent.* **49** no. 4 pp. 557–558, 2 refs. Menasha, Wis., 1956.

In further investigations on the control of a DDT-resistant strain of *Epitrix cucumeris* (Harris) on potato in Connecticut [*cf. R.A.E.*, A **45** 324], various insecticides in wettable-powder sprays were applied on 1st and 14th June 1955; 0·083 lb. dieldrin and 0·25 lb. endrin per acre reduced the number of feeding punctures on 21st June by 90·7 and 95·4 per cent., respectively, and 0·028 lb. dieldrin, 0·083 lb. endrin and 2 lb. DDT by 86·9, 77·3 and 79·1 per cent. Endrin gave similar control at 0·25 lb. in 100 U.S. gals. spray per acre in another district.

Vanderzant (E. S.), Reiser (R.) & Ivy (E. E.). **Methods for the Mass Rearing of the Pink Bollworm.**—*J. econ. Ent.* **49** no. 4 pp. 559–560, 2 refs. Menasha, Wis., 1956.

The authors describe two methods of rearing *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) in the laboratory. In the first, aseptic, method, fresh peas, or peas or beans that had been allowed to sprout, were autoclaved at 15 lb. pressure for 15 and 20–25 minutes, respectively, infested with newly hatched larvae and kept at 84°F. The larvae entered the seeds and did not reappear until they reached the fourth instar. When pupae were found, these and the remaining larvae were collected, and the larvae were transferred to wet cotton-wool to pupate. The largest and most rapidly developing larvae were obtained from sprouted peas; pupae were formed in 14 days and weighed about 20 mg., so that they were comparable with field individuals. Larvae reared on fresh peas were smaller, but all pupated in 15–18 days and gave rise to normal moths. Males and females were produced in about equal numbers, and egg production appeared to be high. Pupae were formed in 16–17 days on sprouted beans and weighed about 13 mg. The same method used with sprouting cotton seeds was unsuccessful, probably because autoclaving destroyed some essential nutrient.

For the second method, delinted cotton seeds were soaked, allowed to sprout and then dipped in a solution of Butoben (n-butyl parahydroxybenzoate) and methylcellulose for five minutes and allowed to dry before being infested with newly hatched larvae or eggs about to hatch. The infested seeds were kept at a mean temperature of about 80°F. and 70–90 per cent. relative humidity. The larvae entered the seeds, and left them to pupate after 11 or more days, which is comparable with their behaviour on cotton squares. The pupae averaged 18·1 mg. in weight. The coating applied to the seeds prevented drying and inhibited mould growth for about a week, which was sufficient to permit larval development. Microbial decomposition within sprouting peas and beans rendered this method unsuitable for them.

The use of sprouted peas is preferred, as fresh peas are not always available and sprouted beans seemed less suitable; however, the preparation of the seeds takes time, and care must be taken to avoid contamination. The cotton-seed method is easy and rapid, and might prove suitable if improved to give better yields.

Enkerlin-S. (D.) & Hanna (R. L.). **The Dilution of Dust Concentrates in Pink Bollworm Control.**—*J. econ. Ent.* **49** no. 4 p. 560. Menasha, Wis., 1956.

An experiment was carried out at College Station, Texas, in 1955, to compare the effects of dilute and concentrated dusts, applied to give the

same amount of actual insecticide per acre, in controlling *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) on cotton. Dusts of 20 per cent. DDT with 3 per cent. dieldrin and 10 per cent. DDT with 1·5 per cent. dieldrin were applied at about 10 and 20 lb. per acre, respectively (2·3 lb. actual insecticide), and 5 and 2·5 per cent. Bayer 17147 [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate] at the same rates (0·5 lb. actual insecticide), six times at seven-day intervals from 2nd July to 9th August against an early infestation. Weekly examination of green bolls showed that dust concentration had no effect on the proportion infested or on the number of mines per 50 bolls. Bayer 17147 caused significantly greater reductions than the DDT-dieldrin mixture in the percentage of bolls infested but not in the number of mines. There were no significant differences in yield between any treatments, and it is therefore concluded that small quantities of a concentrated dust may be as effective as large quantities of a diluted one, provided that applications are carefully made.

Griswold (C. L.). **Transmission of the Oak Wilt Fungus by** *Pseudopityophthorus minutissimus* **(Zimm.).**—*J. econ. Ent.* **49** no. 4 pp. 560–561, 3 refs. Menasha, Wis., 1956.

In an experiment in Ohio in 1955, 40 newly emerged adults of *Pseudopityophthorus minutissimus* (Zimm.) [*cf. R.A.E.*, A **42** 99] were allowed to crawl for half an hour on 8th June on a sporulating mat culture of the oak-wilt fungus (*Endoconidiophora fagacearum*) producing only endospores and were then transferred to a cage containing a healthy three-year-old oak seedling. They fed on the seedling within an hour, producing injuries in the crotch, bud axils and leaf axils, and survived for 12 days. Six leaves on a lower branch showed symptoms of the disease by 8th July, and most of the leaves by 13th July. On 17th July, *E. fagacearum* was found growing abundantly in cultures of chips taken from the stem and root. The fungus might be transmitted by this bark-beetle in the field, should feeding be preceded by contact with naturally occurring sporulating mats.

Kring (J. B.). *Piesma cinerea* (**Say**) **feeding on Potato Foliage.**—*J. econ. Ent.* **49** no. 4 pp. 561–562, 7 refs. Menasha, Wis., 1956.

Piesma cinereum (Say) was found feeding in numbers on pigweed (*Amarantus retroflexus*) and potato in Connecticut in 1955, causing foliage discoloration on both plants. Sprays of wettable DDT, applied to potato at 0·667–2 lb. actual toxicant per acre, and of wettable dieldrin and endrin at 0·083–0·25 lb. per acre, on 1st and 14th June for the control of the flea-beetle [*Epitrix cucumeris* (Harris)] caused 65·3–79·3 per cent. reduction in discoloured feeding areas due to *P. cinereum* by 21st June.

Sakimura (K.). *Kurtomathrips morrilli*, **a Non-vector of the Spotted Wilt Virus, with Notes on** *Liothrips urichi*.—*J. econ. Ent.* **49** no. 4 p. 562, 7 refs. Menasha, Wis., 1956.

Since the virus of spotted wilt, which is transmitted by *Thrips tabaci* Lind., is sporadically but persistently destructive to crop plants in Hawaii, two recently introduced species of thrips were examined to determine whether they were possible vectors of it.

One of them, *Kurtomathrips morrilli* Moult., was first found in April 1954 and has been observed only on *Pluchea odorata*, a common weed, in a localised area on Oahu. In tests, it fed freely on *Emilia sonchifolia*, the

principal weed host of the virus, but not on *Nicotiana tabacum* or *N. rustica*. The life-cycle lasted about 30 days in November at an average mean temperature of 76·5° F. and about 35 days in January and February (71·5° F.). Adults were collected from 11 colonies on *P. odorata* and transferred to infected *E. sonchifolia*. After 30–40 days, their adult progeny were transferred in pairs to 126 healthy *E. sonchifolia* plants, between November 1954 and April 1955, but no infection resulted and it is concluded that this thrips is not a vector of the virus.

The other, *Liothrips urichi* Karny, was introduced from Fiji and liberated on Oahu in April 1953 against the recently established noxious weed, *Clidemia hirta*. It did not feed on infected *E. sonchifolia*, *N. rustica* or *Datura stramonium* var. *chalybea*, so that it is unlikely to disseminate the virus, and attempts to infect *C. hirta* with the latter by inoculation of sap were unsuccessful, indicating that it is not susceptible to the virus.

Fife (L. C.). **Seasonal Occurrence of resting Larvae of the Pink Bollworm in central Texas.**—*J. econ. Ent.* **49** no. 4 pp. 562–563, 1 ref. Menasha, Wis., 1956.

As the principal measures against *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) on cotton are designed to reduce the population of resting larvae, which remain dormant for several months or years before pupating, a knowledge of their seasonal abundance in different areas is desirable. Infested green cotton bolls were collected each week of the growing season of 1955 in central Texas, and mature larvae from them were permitted to spin cocoons under thin disks of absorbent cotton-wool and kept under conditions similar to those out of doors until the time of writing (February 1956). They were classified as resting if they did not pupate within 30 days, and such larvae were present in all samples, comprising 3–5 per cent. of the individuals collected in August, 25–64 per cent. in September, 93–94 per cent. in October and 100 per cent. in November. Few larvae pupated after the 30-day period or after 1st December, when temperatures were usually too low for further development, and few exit holes were observed in late-maturing green bolls in October and November, indicating that most of the resting larvae remain in the open bolls. It would thus be necessary to harvest an early crop and to destroy the stalks by mid-September to effect much reduction in the numbers of resting larvae in the area, and as this is impracticable, measures should be directed towards the reduction of populations after most of the larvae have entered the resting stage.

Resting larvae were numerous in open bolls and locks of cotton of the 1954 crop collected from the ground or from standing stalks in January–March 1955 in fields in which maize, lucerne, small grains or cotton followed cotton, and fairly numerous in the last three in May and June; none was found from 15th July to the end of August. Open bolls from standing stalks contained 185, 91 and 50 resting larvae per lb. on 21st April, 17th May and 10th June, respectively, and the first open bolls collected from two fields of the 1955 crop contained 6 and 7·5 per lb. on 25th July. Moths emerged from 17th March to 29th August from infested bolls caged on 15th November 1954, and it is concluded that resting larvae are present in every month of the year in central Texas.

Haines (R. G.). **Evidence of Lindane Translocation in Corn Plants.**—*J. econ. Ent.* **49** no. 4 pp. 563–564, 9 refs. Menasha, Wis., 1956.

In the experiments described, maize seedlings were grown in nutrient solutions to which solutions of about 1·5 parts per million lindane [almost

pure γ BHC] were added, and the distribution of the insecticide in the plants was tested by bioassay of guttated liquid from the leaves and of extracts of leaf and stem-sheath tissue, larvae of *Aëdes aegypti* (L.) being used as the test insects.

The concentration of toxicant in the guttated liquid of plants that were exposed to γ BHC for 22 days rose from 0·009 p.p.m. on the sixth day to 0·017 on the 21st when the γ BHC concentration in the nutrient was 0·25 p.p.m. and from 0·009 p.p.m. on the 17th day to 0·012 on the 22nd when it was 0·05 p.p.m. It reached 0·009 p.p.m. on the 21st day when the concentration was 0·0185 p.p.m. The concentrations found in the leaf blades and in the stem and sheath at the end of the treatment were 0·17 and 0·5 p.p.m. for plants grown in 0·25 p.p.m. γ BHC, 0·06 and 0·1 p.p.m. for those in 0·05 p.p.m., and 0·03 and 0·05 p.p.m. for those in 0·0185 p.p.m., and the corresponding quantities in plants exposed to γ BHC for 26 days were 0·21 and 0·61, 0·07 and 0·11, and 0·04 and 0·05 p.p.m. The guttated liquid and extracts of the leaves, stems or sheaths of untreated plants were non-toxic. The nature of the toxic material was not demonstrated, but it was assumed to be γ BHC, and the results therefore give further evidence of translocation of this insecticide in plants [*cf. R.A.E.*, A **39** 15; **43** 180, etc.].

Jacobson (F. B.) & Hipp (W. A.). **A new Device for Spot Fumigation of Conveying Equipment.**—*J. econ. Ent.* **49** no. 4 p. 565, 1 fig. Menasha, Wis., 1956.

Since conveyor equipment of the older type in grain mills and other food-processing plants is frequently difficult to fumigate owing to poor access for the fumigant, a device was developed and patented in the United States to facilitate the application of liquid fumigants to it. The liquid is held in a covered container and evaporates from the end of a wick into the conveyor conduit, to which the apparatus is fastened by means of a base plate. The conduit can be sealed off from areas not requiring fumigation, there is little danger of contamination, and the time and labour necessary to apply the fumigant and aerate the equipment after treatment are reduced.

Polivka (J. B.). **Effectiveness of Chlordane in controlling the Japanese Beetle Larvae.**—*J. econ. Ent.* **49** no. 4 pp. 566–567, 1 ref. Menasha, Wis., 1956.

In field tests in various localities in eastern Ohio, single applications of chlordane as a dust or in water were made to soil plots in September 1946, October 1947, April 1948, April, June or August 1949 or May 1950 for the control of larvae of the Japanese beetle [*Popillia japonica* Newm.]. Examination of soil samples for up to six years thereafter showed that applications of 5 lb. or more chlordane per acre gave some control in the year of treatment and practically complete control in all later ones [*cf. R.A.E.*, A **38** 60]. Chlordane at 1 lb. per acre gave some control throughout the period.

Daniels (N. E.). **Greenbug Eggs below the Thirty-fifth Parallel.**—*J. econ. Ent.* **49** no. 4 p. 567, 2 refs. Menasha, Wis., 1956.

Eggs of *Toxoptera graminum* (Rond.) overwinter in the northern United States, but were thought to be laid rarely or not at all south of 35°N. lat., except at high altitudes [*cf. R.A.E.*, A **10** 10]. They are normally laid in autumn, though males, oviparae and eggs were observed in Washington,

D.C., in April 1908. In 1955, eggs that apparently belonged to this species, though they did not hatch, were found in March–April on the upper surfaces of barley leaves in a greenhouse at Amarillo, Texas, just north of the 35th parallel. The Aphid was present in the neighbouring Hereford area, just south of the 35th parallel, during October of the three years 1954–56, but was not reported in the surrounding States for at least two months prior to October in 1956, so that the local infestation did not appear to be due to migration. The Aphid may therefore pass the summer in the egg stage at some high altitudes south of the parallel.

Scott (L. B.). **The Sugarcane Beetle damages Tobacco in Tennessee.**—*J. econ. Ent.* **49** no. 4 p. 567. Menasha, Wis., 1956.

Adults of *Euetheola rugiceps* (Lec.) are not normally important in Tennessee, but damaged isolated plantings of tobacco in the north-central part of the State in 1955. They attacked the stems of the seedlings at or just below ground level, and though the injury was not immediately apparent when there was adequate soil moisture, practically all the weakened plants wilted and died soon after the onset of a mild drought. There was only a trace of injury after an application of 20 per cent. toxaphene dust to individual plants or of 2 U.S. quarts 23 per cent. aldrin emulsion concentrate per acre disked into the top three inches of soil, and dead beetles were found on the soil surface for two months after treatment. *E. rugiceps* also damaged maize in Tennessee in 1955, and the heavier infestations on tobacco were adjacent to infested maize.

McPhail (M.) & Guiza (F. E.). **An Oviposition Medium for the Mexican Fruit Fly.**—*J. econ. Ent.* **49** no. 4 p. 570. Menasha, Wis., 1956.

A hollow hemispherical dome constructed of cheesecloth, paraffin and petrolatum, and coloured orange, was found to be an excellent medium for obtaining large numbers of eggs of *Anastrepha ludens* (Lw.). The females readily punctured the dome and deposited eggs on its inner surface, from which they could be brushed or washed out. For rearing, the dome was kept moist by means of wet cotton-wool placed under it or by spraying its interior with water. The colour and shape of the dome were important, and its usefulness was not impaired by six months' use.

Moreland (C. R.). **Spraying Cloth Patches with Fabric Protectants.**—*J. econ. Ent.* **49** no. 4 pp. 570–571, 5 refs. Menasha, Wis., 1956.

When commercial liquid insecticides designed for the protection of fabrics from insects are tested in comparison with a standard at the Pesticide Testing Laboratory, Canada, they may not be diluted or otherwise modified, the dosage applied has to be evaluated in terms of total deposit, and uniformity of application over the cloth surface is essential. As no standard method of application was available, one in which patches of woollen cloth are sprayed on both sides with known quantities of insecticide in a spray chamber was developed and is here described.

Brett (C. H.) & Brubaker (R. W.). **Potato Leafhopper Control on Snap Beans.**—*J. econ. Ent.* **49** no. 4 p. 571. Menasha, Wis., 1956.

Empoasca fabae (Harris) occurs each year on snap beans in a mountain area near Hendersonville, North Carolina, and was particularly numerous in

1955, after a late, cool spring and heavy rainfall. In a test on control, dusts were applied at 25 lb. per acre on 15th and 19th July, and counts made between 28th July and 4th August showed that 5 per cent. Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)] or methoxy-DDT (methoxychlor) and 20 per cent. Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of about 66 per cent.] gave 88, 80 and 78 per cent. control of the nymphs, respectively, whereas 4 per cent. malathion, 1 per cent. rotenone from cubé and 1 per cent. from *Tephrosia vogelii* gave 30, 16 and 11 per cent. Mixtures of 3 per cent. malathion with 3 per cent. ethyl-DDD or methoxy-DDT gave 74 and 62 per cent. control, respectively.

Wylie (W. D.). **Trunk Sprays for Peach Tree Borer Control.**—*J. econ. Ent.* **49** no. 4 p. 574. Menasha, Wis., 1956.

Aegeria (*Sanninoidea*) *exitiosa* Say is a serious pest of peach in Arkansas. Fumigation with p-dichlorobenzene in autumn gives fair control, but is laborious, and trunk spraying to prevent the entry of newly hatched larvae [*cf. R.A.E.*, A **42** 98] did not give good results because the protracted oviposition period necessitates protection for five months and the insecticides used afforded it for only three weeks. In 1955, trees were sprayed from ground level to the main scaffold branches with about 3 U.S. pints each of a mixture of 6 lb. 50 per cent. wettable dieldrin in 100 U.S. gals. water on 21st June, when there were indications of recent entries, or 9th September. Periodical observations throughout the season revealed no new entries in the trees sprayed on the first date, but the numbers of larvae in the trees sprayed in September did not differ appreciably at the end of that month from those in untreated trees. Some of the trees sprayed in June were artificially infested with large numbers of eggs on 8th September, and there were indications of a few new entries on these by 27th September. Nevertheless, on 6th March 1956, there was no evidence of borer activity in them, the larvae having apparently failed to survive.

d'Araujo e Silva (A. G.). **Seis novas brocas da laranjeira. II. Falsas brocas das pontas.** [Six new Borers on Orange. II. False Tip Borers.]—*Bol. fitossanit.* **6** no. 3–4 pp. 119–124, 1 pl., 7 refs. Rio de Janeiro, 1956.

In this second part of a paper [*cf. R.A.E.*, A **44** 303], the author quotes the original descriptions of four Longicorns found boring in orange or other fruit trees in Brazil, with local records of their occurrence. All are thought to attack dead wood only.

Gonçalves (C. R.). **Dados sôbre a biologia do gafanhoto do nordeste.** [Data on the Bionomics of the Locust of north-eastern Brazil.]—*Bol. fitossanit.* **6** no. 3–4 pp. 145–150, 1 pl. Rio de Janeiro, 1956.

The Acridid present in north-eastern Brazil and previously thought to be *Schistocerca cancellata* (Serv.) [*cf. R.A.E.*, A **44** 303] was recently identified as *S. pallens* (Thnb.). It was reared in insectary cages from April 1955 to March 1956, and at average temperatures of 23·9°C. [75·02°F.] and 22·7°C. [72·86°F.], the eggs hatched in 46–55 and 59–63 days, respectively. The duration of the hopper stage ranged from 52 days in February–March to 118 days in June–October, but is probably less in the field, where exposure to sunlight would be greater. The preoviposition period lasted 39–80 days, the eggs being laid over a period of two months, and the adults

survived for up to 120 days, with no clear temperature relation. Females collected in a cotton field on 28th April 1955 gave rise to hoppers from 25th June to 25th August. Hoppers of a second generation hatched from 12th January to 1st February, and those of a third from 23rd May to 7th June.

Mariconi (F. A. M.) & Zamith (A. P. L.). **Notas sôbre un sério depredador de flores.** [Notes on a serious Pest of Flowers.]—*Biológico* **23** no. 3 pp. 41–49, 6 figs., 18 refs. São Paulo, 1957.

The adults of *Macrodactylus pumilio* Burm. cause severe losses to commercial growers of flowers near Piracicaba, São Paulo. The distribution, bionomics and food-plants of this Melolonthid are reviewed, both sexes are briefly described, and an account is given of further experiments on control [*cf. R.A.E.*, A **45** 111], carried out in 1956, when damage was severe. In laboratory tests, marguerite flowers were sprayed and females confined with them when the deposits had dried. BHC and lindane [almost pure γ BHC] applied to give 0·01 or 0·02 per cent. γ isomer and parathion at 0·01 or 0·02 per cent., all in wettable-powder sprays, gave excellent mortality and were rapid in effect; aldrin, dieldrin and isodrin in wettable-powder sprays, and endrin in an emulsion spray, all applied at 0·05 or 0·1 per cent., also gave good results but did not act rapidly enough to prevent all damage. Malathion at 0·05 or 0·1 per cent. in an emulsion spray and wettable DDT at 0·1 or 0·2 per cent. were inferior.

The use of crude BHC on flowers grown commercially is not advised, because of its disagreeable odour, but γ BHC at 0·05 per cent. in sprays and parathion at 0·5–1 per cent. in dusts [*cf. loc. cit.*] and 0·01 per cent. in sprays should prove satisfactory. In a field test, in which γ BHC in oil was applied from a Swingfog generator [*cf.* **42** 393], the oil caused excessive scorching of the flowers.

Puzzi (D.) & Orlando (A.). **Ensáios de combate às moscas das frutas *Ceratitis capitata* (Wied.) e *Anastrepha* sp. por meio de pulverizações de iscas envenenadas.** [Experiments on the Control of *C. capitata* and *Anastrepha* sp. with Poison Bait-sprays.]—*Biológico* **23** no. 2 pp. 21–25, 1 fig., 7 refs. São Paulo, 1957. **Ensáios preliminares de combate à mosca do mediterrâneo *Ceratitis capitata* (Wied.) por meio de aplicação de inseticidas no sólo.** [Preliminary Experiments on the Control of *C. capitata* by Means of Insecticides applied to the Soil.]—*T. c.* no. 4 pp. 61–69, 3 figs., 6 refs.

The results are given in the first paper of further experiments on the control of fruit-flies (*Ceratitis capitata* (Wied.) and *Anastrepha* sp.) on peach in São Paulo by means of bait-sprays [*cf. R.A.E.*, A **44** 369], carried out in 1956. Dieldrin, malathion and Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], all at 0·1 per cent. in wettable-powder sprays, with the addition of unrefined sugar at the rate of 3 lb. per 10 gals. spray as an attractant, were applied six times between 17th September and 13th November. The fruits were picked on 9th–22nd November, and the percentages attacked averaged 2·5 for dieldrin, 15 for malathion and 25·4 for Diazinon, as compared with 27 for sprays of sugar and water only. The results obtained with malathion and dieldrin were significantly better than those from the other treatments, and the superiority of dieldrin is attributed to the persistence of its deposits. On untreated trees some 55 and 220 yards from the experimental plots, 100 per cent. of the fruits were attacked.

The experiments described in the second paper were carried out in 1956 to determine whether the incorporation of insecticides into the soil beneath trees attacked by *C. capitata* would give control of larvae entering the soil to pupate, the pupae or the newly emerged adults. Glass jars, 8 ins. in diameter, were filled to a depth of about an inch with 2·2 lb. fine sand; aldrin at 7·5 or 3·75 parts per million or chlordane at 12 or 6 p.p.m., both in a diluent, was mixed with the sand on 3rd October, and 100 ripe coffee berries infested by larvae of *C. capitata* were placed in each jar. The diluent alone was mixed with the sand in the control jars. Adult emergence began on 22nd October and continued for three weeks. The total numbers of adults that emerged per five jars and (in brackets) the numbers living were 151 (0) and 314 (13) for aldrin at 7·5 and 3·75 p.p.m., respectively, 404 (52) and 505 (254) for chlordane at 12 and 6 p.p.m., respectively, and 522 (517) for the diluent only. When further lots of 50 infested berries were placed in the same jars on 14th November, the corresponding figures were 224 (13) and 289 (79) for aldrin, 242 (186) and 282 (226) for chlordane, and 290 (278) in the controls. Aldrin was thus superior to chlordane, retained its effectiveness for longer, and, in view of the lower total numbers of adults emerging in the first test, apparently exerted most of its effect against the larvae or pupae.

It is concluded that treatment of the soil immediately beneath infested trees with an aldrin dust would be a useful auxiliary control measure. It should be applied when the fruits are first attacked, but, in view of the migratory habits of the adults, cannot be expected to give complete control alone.

Winteringham (F. P. W.). **Labelled Metabolic Pools for studying quantitatively the Biochemistry of toxic Action.**—*Int. J. appl. Radiat. Isotopes* **1** pp. 57–65, 3 figs., 15 refs. London, 1956. (With Summaries in French, Russian & German.)

The following is virtually the author's synopsis. A powerful method for studying the biochemistry of acute toxic action *in vivo* would be one in which the whole range of metabolites involved in immediate survival could be determined quantitatively in the tissues of control and of poisoned animals. The possibility of doing this with insects has been demonstrated by the application of quantitative radiochromatographic techniques. When house-flies (*Musca domestica* L.) are fed with carrier-free $^{32}PO_4^{3-}$, the entire pool of phosphorylated intermediates of glycolysis, muscle contraction, etc., appears to become rapidly and uniformly labelled. The labelled intermediates may then be extracted, separated on paper chromatograms, and determined by radiometric scanning techniques. Some interesting results have been obtained. For example, exposure of flies to methyl bromide (an SH-enzyme inhibitor) brings about a spectacular depletion of adenosine triphosphate, the entire phosphate sometimes appearing as PO_4^{3-}, and not as adenylic acid or adenosine diphosphate, as might be expected. The nature and relative specific activities of the ^{32}P-labelled intermediates extracted from tissues have been determined by co-chromatographic and neutron activation techniques. This work has recently been extended to the use of ^{14}C-labelled pools by the injection of a suitable substrate such as 2-^{14}C acetate. Certain amino acids and acetylcholine, an important substance in vertebrate nerve-muscle function, have been identified and estimated among the labelled intermediates formed in normal house-flies and in house-flies poisoned with diisopropyl phosphorofluoridate. This substance caused a temporary increase in the acetylcholine level, but also interfered with amino-acid metabolism, which resulted in an accumulation of glutamine.

Bradley (R. H. E.) & Ganong (R. Y.). **Evidence that Potato Virus Y is carried near the Tip of the Stylets of the Aphid Vector** *Myzus persicae* **(Sulz.).**—*Canad. J. Microbiol.* **1** pp. 775–782, 1 pl., 8 refs. Ottawa, 1955.

The following is virtually the authors' summary. Examples of *Myzus persicae* (Sulz.) infective with potato virus Y were made noninfective by exposing the tips of their stylets to ultraviolet radiations in the 2537 Å wave band. Similar results were obtained when the area around the Aphid was ventilated during irradiation to carry away the ozone produced by the radiations passing through the air. This irradiation did not appear to harm the Aphid even though much of its body was irradiated at the same time. Nor did it affect the infectivity of Aphids when their stylets were enclosed by the labium, or when most of the length of the stylets except the tips was exposed to the radiations. Irradiation did, however, reduce the ability of Aphids immediately thereafter to acquire potato virus Y during a brief feeding puncture, but this was so whether the tips of the stylets were irradiated or not. Furthermore, an hour after being irradiated, Aphids acquired the virus during a brief feeding puncture as readily as did unirradiated controls. It is concluded that irradiation of the tips of the stylets of *M. persicae* inactivated potato virus Y that otherwise would have been transmitted to the test plants. Only virus near the tips of the stylets appeared to be transmitted even after more than the tips had been inserted into infected tobacco plants.

Bradley (R. H. E.) & Ganong (R. Y.). **Some Effects of Formaldehyde on Potato Virus Y** *in vitro*, **and Ability of Aphids to transmit the Virus when their Stylets are treated with Formaldehyde.**—*Canad. J. Microbiol.* **1** pp. 783–793, 1 fig., 18 refs. Ottawa, 1955.

The following is the authors' summary. Potato virus Y (PVY) was made noninfective by incubation with formaldehyde *in vitro*. Yet this noninfective virus reacted with PVY antiserum and caused antibodies to be produced in rabbits as readily as infective PVY. A method is described for baring the stylets of living Aphids beyond the end of the labium, which normally encloses the stylets. Specimens of *Myzus persicae* (Sulz.) infective with PVY were made noninfective by treating the stylets for 30 sec. with concentrations of formaldehyde as low as 0·03 per cent.; and 0·25 per cent. formaldehyde caused the same effect in five seconds. Aphids were also made noninfective when the proboscis with the tip of the stylets bared was treated with formaldehyde, even after the stylets had been inserted a considerable distance into infected tobacco plants. By contrast, Aphids usually remained infective when the proboscis with the stylets enclosed in the labium was treated with similar concentrations of formaldehyde. However, formaldehyde treatment of the stylets did not affect the ability of Aphids immediately thereafter to acquire and transmit PVY. These results are compatible with the hypothesis that viruses transmitted like PVY are carried by the stylets of their Aphid vectors [*cf. R.A.E.*, A **44** 265].

di Martino (E.). **Osservazioni ed esperienze di lotta contro la ruggine gialla del limone dovuta al ragno rosso** (*Tetranychus telarius* **L.).** [Observations on Yellow Rust of Lemons caused by *T. telarius*, and Experiments on its Control.]—*Ann. Sper. agr.* (N.S.) **11** no. 1 pp. 115–138, 4 pls. (2 col.), 11 refs. Rome, 1957. (With a Summary in English.)

Injury to lemon in Sicily by *Tetranychus telarius* (L.) [*cf. R.A.E.*, A **25** 341] has increased in recent years, partly as a result of the destruction

of its natural enemies by DDT, which is widely used for the control of *Ceratitis capitata* (Wied.). In 1954, favourable weather for the mite led to considerable damage on the northern and eastern coasts. Development was favoured by high humidity, and populations were high in crowded groves and those in which irrigated vegetable crops were grown beneath the trees. The injury caused by the feeding of the mite on the leaves and fruits is described. When the attack is severe, the trees are defoliated and the crop lost. Sporadic attacks have also been recorded on orange.

Experiments on control were carried out in 1953–54 with various commercial emulsion concentrates and systemic toxicants. Emulsion sprays were applied initially on 1st–5th December 1953, and examination on 10th March showed that the percentages of infested leaves still bearing living mites were lowest (2·84–6·56) for mixtures of 0·05 per cent. Ovotran (p-chlorophenyl p-chlorobenzenesulphonate) with 0·05 per cent. Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) or 0·125 per cent. malathion, white oil at 2 per cent. alone or at 1 per cent. with 0·03 per cent. parathion, and Chlorobenzilate (ethyl 4,4′-dichlorobenzilate) at 0·075 per cent. On untreated trees, living mites were present on more than 57 per cent. of the damaged leaves. On 10th March, half of the trees were retreated with the same materials, further trees received them for the first time, and still others were sprayed with 0·05 per cent. Systox (diethyl 2-(ethylthio)ethyl phosphorothioate [demeton]) or 0·15 per cent. schradan. On 10th May, mites were present to varying degrees on all the trees treated in autumn only, and there were no significant differences between two applications or one only in spring, no mites being present on trees treated with the mixtures of Ovotran and Aramite or malathion, with a mixture of 0·0525 per cent. Ovotran and 0·0225 per cent. parathion, with Chlorobenzilate or (for two applications) with 0·125 per cent. malathion alone. Small numbers were present on trees treated with the systemic materials. At a final examination on 7th July, the percentages of new leaves that had been attacked (as compared with 49 for no treatment) on trees treated in December only, in December and March, and in March only were 11, 8 and 9, respectively, for the mixture of Ovotran and Aramite, 21, 14 and 19 for the mixture of Ovotran and parathion, 29, 23 and 27 for the mixture of Ovotran and malathion, 18, 16 and 18 for Chlorobenzilate, 25, 15 and 17 for white oil alone, and 28, 24 and 20 for white oil with parathion. The corresponding percentages for demeton and schradan were 14 and 19–21. Ovotran, parathion and malathion alone gave inferior results.

In a further test, the trees were sprayed on 12th–15th and 22nd–25th July 1954, or on the first date only, with the various emulsion sprays, except for white oil with or without parathion, and a wetter was added. A few days after treatment, some adults but few immature stages were present on trees treated with Ovotran alone or Chlorobenzilate, and no living individuals on those treated with the mixtures of Ovotran with Aramite, parathion or malathion; the last two materials alone also gave complete immediate control, but high populations developed after a few days. On 10th August, mites or eggs were present on more than 90 per cent. of the injured leaves from untreated trees, and the corresponding percentages after one and (in brackets) two treatments with the most satisfactory sprays were 15·5 (3·75), 7·5–14 (5–6·5) and 12·5 (3) for mixtures of about 0·045 per cent. Ovotran with 0·045 per cent. Aramite, 0·02 per cent. parathion and 0·125 per cent. malathion, respectively, and 14·5 (3·5) for 0·0325 per cent. Ovotran with 0·125 per cent. malathion.

Trees in a further grove were sprayed on 16th–17th and 27th July, or on the first date only. On 17th August, the percentages of injured leaves with eggs or living mites after one and (in brackets) two applications, as compared with 83 for no treatment, were 10·25 (3·5), 12·5–19·75 (6·75–7·5)

and 15 (1·5) for the mixtures of 0·045 per cent. Ovotran with 0·045 per cent. Aramite, 0·02 per cent. parathion and 0·125 per cent. malathion, respectively.

A mixture of Ovotran and malathion with a wetter was applied on 12th August to trees that had been completely defoliated by *T. telarius*, against which considerable amounts of parathion, mineral oil and other products had proved ineffective earlier in the year. Complete mortality was obtained within seven days, and the trees had put out new shoots and resumed an almost normal appearance by mid-September. In another locality, wettable-sulphur applied at 0·25–1 per cent. in mid-September gave no control.

It is concluded that mixtures of Ovotran and Aramite, parathion or malathion, with the addition of a wetter, applied twice at an interval of not more than 7–10 days in summer, give the best protection from injury.

GIRALDI (G.). **Infestazione di *Rhamphus pulicarius* Herbst (Coleoptera, Curculionidae) osservata su ciliegi.** [Infestation by *R. pulicarium* observed on Cherry.]—*Ann. Sper. agr.* (N.S.) **11** no. 2 suppl. pp. cci–ccxii, 6 figs., 15 refs. Rome, 1957. (With a Summary in English.)

In 1955, larvae and adults of *Rhamphus pulicarium* (Hbst.) were observed for the first time attacking the leaves and fruits of cherry near Verona. This weevil, all stages of which, except the pupa, are described, is polyphagous, and its bionomics closely resembled those observed on apple near Kiev [*cf. R.A.E.*, A **17** 339]. For control, fallen leaves, in which the immature stages overwinter, should be collected and burnt [*cf. loc. cit.*] or caged for the emergence of parasites.

VESPIGNANI (A.). **I moderni insetticidi alla prova contro la *Laspeyresia* (*Cydia*) *molesta* Busck.** [Modern Insecticides tested against *Cydia molesta*.]—*Riv. fruttic.* **18** no. 4 pp. 369–381, 7 figs., 6 refs. Ravenna, 1956.

The author briefly reviews from the literature the control measures used against *Cydia molesta* (Busck) on peach, and gives an account of insecticide tests carried out near Bologna in 1955. In the first test, on trees three years old grown in pots, sprays were applied either five times, on 2nd, 12th and 22nd July and 3rd and 13th August, or three times, on 2nd and 17th July and 3rd August. Any shoots or small fruits that were infested were removed before each application. At picking, on 22nd August, the percentages of peaches injured after five and (in brackets) three applications, as compared with over 50 for no treatment, were 2·17 (4·28) for 0·7 per cent. of an emulsifiable paste containing 40 per cent. DDT and 10 per cent. parathion, 13·63 (17·01) for about 0·02 per cent. parathion, 19·23 (21·21) for 0·03 per cent. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], 24·13 (28·3) for 0·125 per cent. malathion, 24·13 (30) for 0·02 per cent. TEPP [tetraethyl pyrophosphate], 25 (33·33) for about 0·03 per cent. endrin, and 25·71 (26·66) for 0·05 per cent. Systox (diethyl 2-(ethylthio)ethyl phosphorothioate [demeton]).

In a second test, carried out on six-year-old trees, sprays were applied four times, on 5th, 15th and 25th July and 5th August, or three times, on 5th and 20th July and 5th August, and infested shoots were not removed. At picking, between 25th August and 1st September, the percentages of fruits attacked after four and (in brackets) three applications, as compared with over 56 for no treatment, were 4·8 (7·75) for the mixture of DDT and parathion, 14·99 (20·6) for 0·02 per cent. parathion, 18·88 (22·26) for the Diazinon spray, 22·88 (25·06) for the malathion spray, 25·28 (31·14) for the

endrin spray, 27·29 (35·71) for the demeton spray, and 32·17 (33·48) for the TEPP spray. None of the sprays proved phytotoxic, but it is pointed out that *Hyaloptcrus amygdali* (Blanch.) (*arundinis*, auct.) was absent from both the treated and untreated trees. When this Aphid is present, repeated applications, particularly of parathion at low concentrations, have been found to cause defoliation, varying in extent with the severity of infestation by it.

DE PIETRI-TONELLI (P.) & ROSI (O.). **Il *Cryptorrhynchus lapathi* L. Un solo trattamento tempestivo con parathion consente di liberare i fusti dalle larve del curculionide.** [*C. lapathi*. A single timely Application of Parathion frees the Trunks from Larvae of the Curculionid.]—*Ital. agric.* **93** no. 12 pp. 957–963, 3 figs., 9 refs. Piacenza, 1956.

The authors review the bionomics and control of *Cryptorhynchus lapathi* (L.) on poplar in Italy [*cf. R.A.E.*, A **42** 110; **44** 203] and give an account of tests near Pistoia in 1956 in which parathion, L 343 (O,O-diethyl S-(isopropylcarbamyl)methyl phosphorodithioate) and L 395 (O,O-dimethyl S-(methylcarbamyl)methyl phosphorodithioate) in liquid formulations were tested against the larvae mining in the trunks of young trees. In this area, the weevil has one generation a year and overwinters as the young larva.

The first test was carried out on heavily infested trees three years old, and the three insecticides were applied to the trunks at 0·1, 0·5 and 1 per cent. by means of a brush on 28th April. The percentages of larvae in the wood and (in brackets) in the bark that were dead on 9th May were 66·7 (100), 100 (100) and 100 (100) for parathion at the three concentrations, respectively, 15·4, 30·8 (100) and 100 (100), respectively for L 395, and 16·7, 21·9 (87·5) and 100 (100) for L 343. The corresponding percentages for no treatment were 3·4 (8·6). As parathion gave the best results, it was further tested on 15th May, when it was brushed at 0·5 per cent. on to the bark of severely infested trees four years old. The percentages of larvae subsequently found dead in the bark, wood and pith were 100, 89·6 and 10·3, respectively, on 22nd May, 100, 98·9 and 50 on 29th May and 100, 88·2 and 0 on 21st June. On untreated trees, mortality was 7·1 per cent. in the bark on 22nd May and 7·2–16 in the wood and 0 per cent. in the pith on the three dates. The treatment killed all larvae within 1 cm. of the trunk surface, but had no effect on the pupae.

It is recommended that the trees should be treated with parathion from ground level to above the highest point of infestation, when the larvae are beginning to mine but are still in the bark; 0·1 per cent. should give effective control, but the concentration should be increased to 0·5 per cent. if the infestation has become established and the larvae are further from the surface.

WHELLAN (J. A.). **A Grain Pest new to Rhodesia.**—*Rhod. agric. J.* **53** no. 1 pp. 41–50, 1 fig., 10 refs.; also as *Bull. Minist. Agric.* [*S. Rhod.*] no. 1861, 11 pp., 1 fig. Salisbury, S. Rhod., 1956.

Trogoderma granarium Everts, which was observed in Southern Rhodesia for the first time at Bulawayo in February 1955 [*cf. R.A.E.*, A **44** 27], was subsequently found to be established on stored grains, beans and other food products in widely separated localities in that territory. It was also discovered in Northern Rhodesia, Nyasaland [*cf.* **44** 341] and South Africa. In view of its wide distribution in Southern Rhodesia, eradication is impracticable, and control measures were directed towards limiting its spread and the intensity of the attack. The larva and adult are described, and the bionomics of the Dermestid are reviewed from the literature. It is thought

likely to pass through ten generations a year in Rhodesia. The difficulties of control are discussed, and general recommendations are made for cleanliness in storage buildings and for fumigation with methyl bromide [*cf.* **45** 259]. At a recently constructed silo at Aspindale, the walls, floors and roofs of infested grain storage sheds were sprayed, at monthly intervals, with a mixture of 1 lb. 10 per cent. γ BHC cattle dip and 3 lb. 50 per cent. wettable DDT in 4 gals. water, applied at the rate of 1 gal. per 1,000 sq. ft. Excellent control of the larvae was obtained, and it is probable that an application every three months would be adequate on farms and smaller storage premises, where the rate of population increase is likely to be less. DDT is not effective against *Trogoderma* but was included to control other grain pests that are not affected by BHC. It is also recommended that a γ BHC dust should be applied between bags of grain during stacking, a concentration of 0·5–1 per cent. being considered suitable.

Whellan (J. A.). **A new Insecticide which can be used in Army Worm Control.**—*Rhod. agric. J.* **53** no. 1 p. 102. Salisbury, S. Rhod., 1956.

During an outbreak of the armyworm [*Laphygma exempta* (Wlk.)] in Southern Rhodesia subsequent to that in 1954 [*cf. R.A.E.*, A **45** 81], complete mortality of half-grown larvae on maize about 2 ft. high was given by 0·5 pint per acre of an emulsion concentrate containing 19·5 per cent. endrin, applied in 50 gals. water from a knapsack sprayer. In another test, complete kill was also obtained when heavy and continuous rain fell a few hours after an application at twice this rate. In a low-volume spray, 1 gal. of the concentrate in 300 gals. water was applied to 20 acres and gave complete kill of larvae in all instars, even when rain fell shortly afterwards.

Georgala (M. B.). **The Biology of Orchard Mites in the western Cape Province.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 360, 13 pp., 5 figs. Pretoria, 1955.

The mites of importance in orchards in the western Cape Province of South Africa are *Bryobia praetiosa* Koch, which has long been injurious, and *Tetranychus telarius* (L.) (*bimaculatus* Harvey), which has greatly increased since the use of DDT sprays against insect pests became general. All stages of both species are briefly described, and characteristics distinguishing them are given. All kinds of deciduous fruit trees are attacked by both, with the apparent exception of apricot. Leaves infested by *B. praetiosa* become mottled and bronzed and young leaf and flower clusters are frequently damaged, especially on apple and pear. Leaves attacked by *T. telarius* turn yellow and fall, and pear fruits are blemished at the calyx end. Both mites damage young buds in the axils of infested leaves. The overwintered eggs of *B. praetiosa* hatch over a protracted period in spring, with a peak during the latter half of October and early November. Several overlapping generations develop during the summer, and there were six on apple in the laboratory, lasting 22–33 days each. Overwintering eggs are deposited in early February and March, when most of the mites migrate to the woody parts of the tree. Population counts on heavily infested apple in 1950–51 showed that numbers were at a peak from about mid-December till the end of January, after which there was a rapid decrease. *T. telarius* migrates to the trees in late December or early January from vegetation in and round the orchards and increases rapidly, especially in hot, dry weather. There may be 6–8 generations a season, and they last about 16 days each in midsummer and about 30–35 days in autumn and early winter. It leaves the trees as soon as

temperatures drop. When it invades trees already infested by *B. praetiosa*, it becomes dominant, and *B. praetiosa* is restricted to leaves free from the webbing produced by *T. telarius* or, on apple, to the midrib on the upper surface of the leaf. Severe infestations by both species can be controlled in summer by sprays of parathion [*cf. R.A.E.*, A **41** 419; **43** 364]. Dormant apple and pear trees on which eggs of *B. praetiosa* are numerous at the beginning of August should be sprayed with 4 gals. winter oil and 4 gals. lime-sulphur in 92 gals. water, but the concentration should be reduced to 3 gals. each of oil and lime-sulphur in 94 gals. water for plum. Light infestations on peach can be checked by a winter spray of lime-sulphur, but spring or summer treatments are generally required.

Betrem (J. G.) & Ossowski (L. L. J.). **The Nomenclature of** *Acanthopsyche junodi* **Heylaerts (Lepidoptera: Psychidae).**—*Proc. R. ent. Soc. Lond.* (B) **25** pt. 11–12 pp. 205–209, 1 fig., 18 refs. London, 1956.

The Psychid that attacks wattle [*Acacia*] in South Africa has long been known as *Acanthopsyche junodi* (Heyl.). From studies of the literature, of museum collections, and of over 100 adult males from different parts of the wattle-growing area of South Africa, the authors conclude that it was incorrectly placed in *Acanthopsyche*, which is a Palaearctic genus, and that the only other Psychids possessing most of its main characters are *Chaliella doubledaii* (Westw.) from Ceylon and *Kotochalia shirakii* Sonan from Formosa. *Chaliella* is considered to be congeneric with *Kotochalia*, and *A. junodi* is transferred to the latter, in which the subgenus *Chaliopsis* is erected for it.

Martyn (E. J.). **Report on an Outbreak of the Southern Armyworm,** *Persectania ewingii* **(Westw.), in Tasmania in 1954–55.**—*Tasm. J. Agric.* **26** no. 4 pp. 329–331, 2 refs. Hobart, 1955.

A further outbreak of *Persectania ewingii* (Westw.) occurred in Tasmania in 1954–55 [*cf. R.A.E.*, A **43** 347]. The main infestations occurred on oats, rye-grass [*Lolium perenne*] grown for seed, and pasture, but wheat, barley, rye and peas were attacked in some areas. The outbreak was more localised and, except in the north-east, less severe than the previous ones. Unusual loss of yield occurred in wheat of one variety, in which the complete heads fell, and in oats in another district, in which the grain was extensively damaged but did not fall. The crops were harvested early in many districts to minimise damage, and good control was given by DDT in a dust or low-volume spray [*cf.* **43** 348]. Pasture was also infested on King Island and Flinders Island, but no treatments were applied.

Papers noticed by Title only.

Russo (G.) & Santoro (R.). **Esperimenti di lotta antidacica eseguiti in Ascea (Salerno) nel 1954.** [Experiments on the Control of *Dacus oleae* (Gmel.) on Olive in Ascea (Salerno) in 1954.]—*Ann. Sper. agr.* (N.S.) **11** no. 1 pp. 65–114. Rome, 1957. (With a Summary in English.) [*See R.A.E.*, A **45** 131.]

Bärner (J.). **Bibliographie der Pflanzenschutzliteratur. Bibliography of Plant Protection . . . 1946–1947.**—xli + 460 pp. Berlin, P. Parey, 1957. Price *DM.* 44.50. [*Cf. R.A.E.*, A **42** 32; **44** 400.]

INDEX OF AUTHORS

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